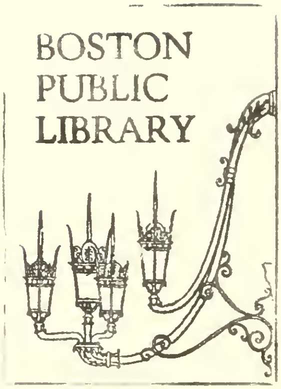

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NEW ENGLAND MEDICAL CENTER/
CHINATOWN HOUSING
TRANSPORTATION STUDY

BOSTON, MASSACHUSETTS

FINAL REPORT

Prepared for:

BIND

ASIAN COMMUNITY DEVELOPMENT CORPORATION,
CHINESE ECONOMIC DEVELOPMENT COUNCIL, INC.,
NEW ENGLAND MEDICAL CENTER, INC., and
TUFTS/NEW ENGLAND MEDICAL CENTER, INC.

by:

HOWARD/STEIN-HUDSON ASSOCIATES, INC.
38 CHAUNCY STREET
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SEPTEMBER, 1992

NEMC Real Estate, Inc.

Robert P. Bland
President

A Subsidiary of
New England Medical Center

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September 10, 1992

Mr. Paul Barrett, Executive Director
Boston Redevelopment Authority
City Hall, Ninth Floor
Boston, MA 02201

Dear Mr. Barrett:

With this letter, I am pleased to submit the accompanying copies of the New England Medical Center Master/Plan Chinatown Housing Transportation Study for approval by the Boston Redevelopment Authority Board. As you will recall, this study was required as a condition of Master Plan approval in March 29, 1990. Its purpose was to provide a comprehensive overview of the transportation impacts of NEMC Master Plan development through the Year 2000, along with proposed Chinatown housing developments on Parcels A and B.

The Medical Center commissioned the study, which was conducted with extensive participation by a committee of representatives of the Chinese Economic Development Corporation (Parcel A developers) and the Asian Community Development Corporation (Parcel B developers), as well as the Chinatown Neighborhood Council's Land Use Committee. Each of these committees has approved the Transportation Study. The Boston Redevelopment Authority also was involved throughout this community process.

Since the draft of the study was circulated and approved in June-September, 1991, there have been several changes in the Chinatown housing developments which are not reflected in the analysis. On Parcel A the original proposal was for 141 housing units and 160 parking spaces. The current proposal is for 167 housing units (maximum) and 84 parking spaces. On Parcel B, the original proposal was for 120 housing units and 90 parking spaces. The current Oak Terrace proposal has been reduced to 88 housing units with 46 parking spaces. The total number of housing units between the two projects is slightly less than the figure analyzed in the transportation study, and the number of parking spaces reduced by almost half. Thus, the traffic analysis, which showed no significant impacts for the housing project, is still valid.

In addition, there have been several changes to the NEMC Master Plan amendment which you are also considering at this time.

The updated, site specific transportation analysis for the current 1C building program is included in the 1C FPIR/FEIR which is before you at this time as well.

Thank you for your consideration of this project.

Sincerely yours,

Robert P. Bland

cc: Gerard Kavanaugh
Dennis Callahan
Larry Smith

RPB:lak

NEW ENGLAND MEDICAL CENTER/CHINATOWN HOUSING TRANSPORTATION STUDY

OVERVIEW/EXECUTIVE SUMMARY

This study was undertaken to describe and analyze the access requirements and impacts of the proposed New England Medical Center (NEMC) Master Plan (July, 1989) and Chinatown community developments, for master planning and environmental review purposes, as required by the City of Boston and the Massachusetts Environmental Policy Act (MEPA) office. These developments are:

* NEMC Master Plan Phase 1 development consisting of 252,000 SF including additional hospital beds and research space.

* An expansion of the Herald Street Garage to provide for employee/student parking demand, along with Castle Square Housing residential requirements.

* Chinese Economic Development Council (CEDC) rental housing on Parcel A, consisting of 141 residential units and 160 parking spaces.

* Asian Community Development Corporation (ACDC) rental housing on Parcel B, involving 120 residential units and 90 parking spaces.

* A 90,000 SF Recreation Center on Parcel C.

The purpose of this study is to give an overview of the combined impacts of the NEMC Master Plan development which can be expected by the design year (2000) and the three community projects so that cumulative impacts and any potential problem areas within a broad study area can be identified. Subsequent to this overview planning study, local impacts and issues specific to each individual project will be covered in more detail through the City of Boston and Massachusetts Environmental Policy Act review processes.

Study Methodology

The study employed accepted traffic and transportation engineering methods for the description and analysis of existing and future access conditions. It considered access of all kinds, via automobile, transit, and walking, assembling data from surveys, inventories and other studies, to determine existing conditions and travel habits. With this as a base, estimates of proposed project travel demand by all modes were made to the future analysis year 2000. Projections were also made of growth in travel demand from other downtown

Boston developments to the same future year. This growth in tripmaking was assigned to the transportation system to analyze future conditions. First, analyses are conducted to reflect a condition of growth which would occur by the Year 2000 in the event that the NEMC and Chinatown projects analyzed in this study are not built ("No-Build" condition). Then, the volumes generated by the NEMC and Chinatown projects are added to the Year 2000 "No-Build" traffic and then analyzed as the "Build" condition.

For automobile access, analyses were applied to 27 Study Area intersections, where Levels of Service (LOS) was calculated for both the AM and PM peak hours. Transit requirements were related to the various subway and bus lines, while pedestrian conditions were analyzed more qualitatively with respect to specific pedestrian route conditions.

Existing Conditions

Travel surveys and census information show that people in the Study Area depend considerably on transit and walking for access, thereby helping to reduce vehicular congestion which greater auto reliance would cause. The mode choices of employees, visitors and residents are summarized as follows:

Mode	NEMC Employees (%)	NEMC Visitors (%)	Parcel A & B Residents (%)	Parcel C Employees (%)	Parcel C Visitors (%)
Walk (& other)	3	11	57	5	40
Transit	44	29	10	65	33
Automobile	53	60	33	30	27

LOS analyses at intersections rate conditions from 'A' to 'F' based on average vehicle delay, with A representing little or no delay (>5 sec.) and F more than one minute of average delay. LOS D or better is considered acceptible in urban conditions. Of the 27 intersections analyzed under existing conditions, only 3 operated at worse than LOS D in either peak hour.

The area is served by 2,888 off-street and 456 legal on-street parking spaces. Although some vacancies can usually be found, these facilities experience an average early afternoon usage rate of about 90%.

Future Conditions - Year 2000

"No-Build" estimates of future travel growth without the proposed projects were made, based on projections made in the Boston Crossing Environmental Impact Report (EIR), as required. This resulted in an increase of about 23% being added to both the ex-

isting AM and PM peak hour vehicular traffic volumes, including allowance for further development of the Tufts University Medical School. A similar increase could be expected for both transit and walk modes.

Intersection LOS analyses for the No-Build condition showed a significant worsening in traffic conditions, with 6 intersections showing a LOS worse than D in either peak hour, 3 more than under existing conditions. A more positive statement is that 21 of the 27 intersections analyzed still would operate at LOS D or better.

Project Impacts

Trip generation calculations for the proposed projects resulted in an additional 286 AM peak hour, and 314 PM peak hour vehicular trips being distributed and added to the No-Build volumes to yield the Build conditions. The assignment of these trips recognized the different parking locations within the Study Area. Build LOS analyses resulted in no more intersections showing LOS worse than D, compared with the No-Build situation. A major conclusion here is that **the proposed projects' addition of traffic to Study Area streets is minor compared to estimated growth from other sources**. This can be graphically seen in the exhibit on the next page which presents total PM peak hour approach volumes volumes at key intersections in the form of a bar chart. Also exhibited is a comparison of LOS analysis results for all three conditions.

All analyses were first performed assuming the existing street and roadway network as a base case. Alternative conditions involving the construction of the new Central Artery and Third Harbor Crossing (CA/T) project and some Turnpike ramp changes were also evaluated, using computer network traffic assignments. The ramp changes involved the proposed elimination of the outbound Arlington Street on-ramp, and the addition of an outbound off-ramp at Berkeley Street and an inbound on-ramp at Tremont Street, coupled with an extension of Herald Street to Clarendon Street. The Tremont Street ramp with Herald Street extension has been recently eliminated from State and City planning, but the Berkeley Street Ramp is being subjected to an EIR by the Turnpike Authority.

The CA/T project showed a significant overall decrease in Study Area traffic volumes (due to reduced Central Artery bypass traffic on local streets), such that, on the average, volumes were reduced almost to existing levels, with the notable exception of Marginal Road between Hudson Street and Washington Street, due to the connection from Central Artery and new Harbor Tunnel off-ramps directly into Marginal Road. Here, volumes will increase significantly -- from 2,400 vehicles per day to around 18,000 per day. The current CA/T plan will transform this section of Marginal Road from a local street to a major arterial, and bring significant additional traffic past the Parcel A housing site with possible air quality impacts. The ramp connections into Marginal Road are thus vigorously opposed by the Chinatown community. As long as these CA/T off-ramp connections into Marginal Road remain, the addition of new Turnpike ramps has only minor additional effect on intersections being analyzed. Although serving considerable traffic, the ramps

seemingly attract new traffic from outside of the Study Area more than causing any significant diversion from local streets. Given the neighborhood opposition to the Marginal Road scheme, alternative ramp arrangements are still under active consideration by the Massachusetts Department of Public Works, the City of Boston, and the Massachusetts Turnpike Authority. It is important to note, however, that the relatively modest traffic added by the combined NEMC and Chinatown community center and housing developments can be easily accommodated under whatever alternative is selected.

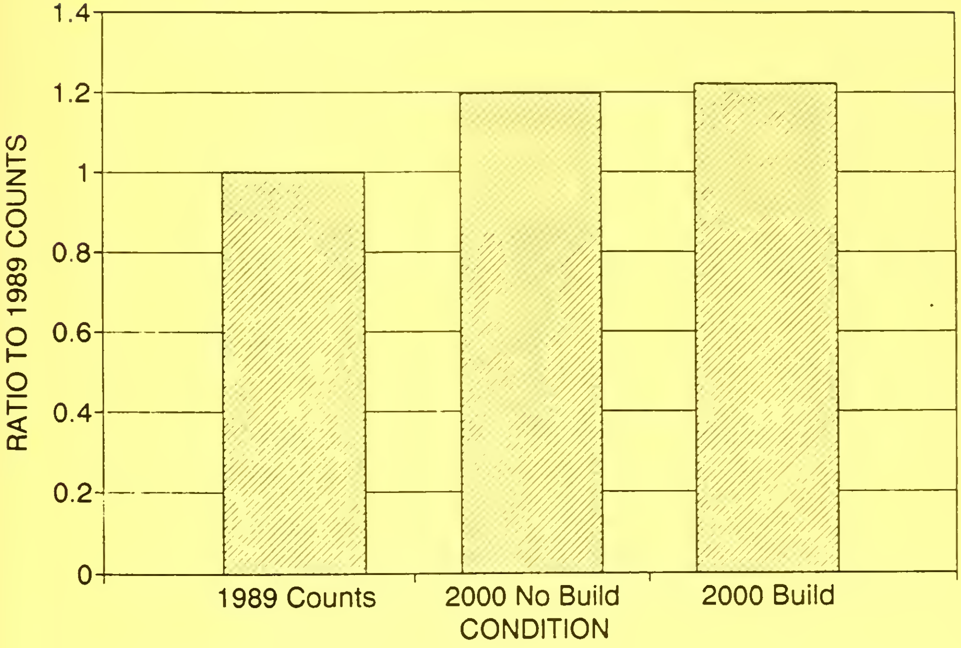
Impact/Mitigation Summary

A general overview of the analyses indicates that the proposed projects add only a minor increment of traffic compared to both existing and No-Build traffic levels. The individual component projects represent, of course, smaller increments.

Actual total traffic impacts should be mitigated significantly in most locations by the construction of the CA/T project, but Turnpike ramp change proposals seem to change Study Area conditions only slightly. In this latter regard, the results of the Turnpike Authority EIR should be watched closely for further elaboration on the subject.

Prior to the construction of any of the proposed projects, Project Impact Reports and Access Plans will required by the City of Boston. In these plans, any changes in parking facility size or locations, building use or size which occur in the design process will be addressed. In addition, specific transportation demand management and systems management measures will be laid out and negotiated.

COMPARISON OF TOTAL APPROACH VOLUMES AT SIXTEEN INTERSECTIONS (PM PEAK)



Comparison of Year 2000
Intersection Levels of Service
in New England Medical Center Study Area

	AM PEAK HOUR						PM PEAK HOUR					
	Existing		No Build (2010)		Build (2000)		Existing		No Build (2010)		Build (2000)	
Location	LOS	Average Delay	LOS	Average Delay	LOS	Average Delay	LOS	Average Delay	LOS	Average Delay	LOS	Average Delay
Stuart/Tremont	B	11 sec	E	57 sec	F	> 60 sec	B	12 sec	F	> 60 sec	F	> 60 sec
Kneeland/Washington	B	12 sec	C	19 sec	C	21 sec	B	9 sec	D	35 sec	D	37 sec
Kneeland/Harrison	B	15 sec	C	19 sec	C	20 sec	D	29 sec	F	> 60 sec	F	> 60 sec
Kneeland/Tyler	B	7 sec	B	8 sec	B	8 sec	B	10 sec	D	29 sec	D	30 sec
Kneeland/Hudson	B	10 sec	C	14 sec	C	14 sec	C	14 sec	D	23 sec	D	25 sec
Kneeland/Surface Artery	C	16 sec	D	34 sec	D	36 sec	D	33 sec	F	> 60 sec	F	> 60 sec
Oak/Tremont	B	8 sec	B	8 sec	B	8 sec	B	8 sec	B	9 sec	B	9 sec
Oak/Washington	B	10 sec	B	11 sec	B	11 sec	B	11 sec	B	12 sec	B	12 sec
Oak/Harrison	A	3 sec	A	6 sec	A	6 sec	A	3 sec	D	22 sec	D	22 sec
Marginal/Arlington	B	7 sec	B	7 sec	B	7 sec	B	9 sec	B	9 sec	B	10 sec
Marginal/Tremont	B	10 sec	B	12 sec	B	12 sec	B	11 sec	B	14 sec	B	15 sec
Marginal/Shawmut	B	9 sec	B	10 sec	B	10 sec	B	11 sec	B	13 sec	B	14 sec
Marginal/Washington	A	3 sec	A	3 sec	A	4 sec	B	5 sec	B	7 sec	B	7 sec
Marginal/Harrison	A	4 sec	A	4 sec	A	4 sec	A	3 sec	A	3 sec	A	3 sec
Herald/Tremont	B	11 sec	B	12 sec	B	13 sec	B	10 sec	B	11 sec	B	11 sec
Herald/Shawmut	B	10 sec	B	10 sec	B	10 sec	B	12 sec	B	15 sec	B	16 sec
Herald/Washington	B	10 sec	B	11 sec	B	12 sec	B	10 sec	B	12 sec	B	14 sec
Herald/Harrison	B	10 sec	B	13 sec	B	13 sec	B	12 sec	D	27 sec	D	33 sec
Herald/Albany	B	14 sec	C	20 sec	C	20 sec	D	27 sec	F	> 60 sec	F	> 60 sec
Herald/Frontage/Broadway	F	> 60 sec.	F	> 60 sec	F	> 60 sec	D	39 sec	F	> 60 sec	F	> 60 sec
E.Berkeley/Tremont	C	15 sec	D	26 sec	D	28 sec	B	13 sec	C	16 sec	C	16 sec
E.Berkeley/Shawmut	B	6 sec	B	6 sec	B	6 sec	B	9 sec	B	9 sec	B	9 sec
E.Berkeley/Washington	B	8 sec	B	8 sec	B	8 sec	B	9 sec	B	9 sec	B	9 sec
E.Berkeley/Harrison	B	10 sec	B	13 sec	B	13 sec	B	10 sec	B	11 sec	B	11 sec
E.Berkeley/Albany	B	14 sec	C	19 sec	C	20 sec	B	14 sec	C	17 sec	C	18 sec
E. Berkeley/Frontage Road/ W. Fourth St.	F	> 60 sec.	F	> 60 sec.	F	> 60 sec	B	12 sec	D	28 sec	D	28 sec

NEW ENGLAND MEDICAL CENTER/CHINATOWN HOUSING TRANSPORTATION STUDY

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1.0 INTRODUCTION

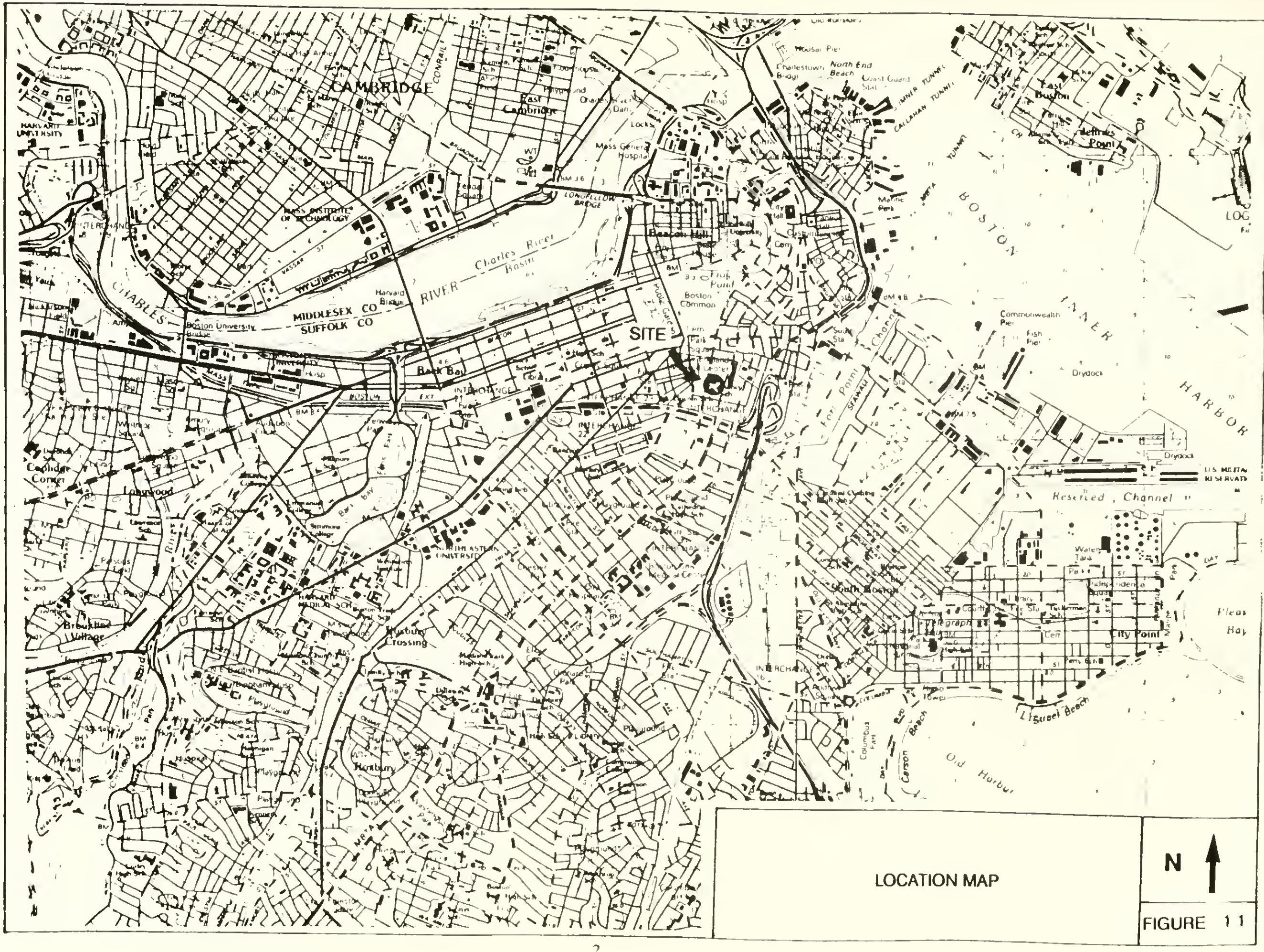
1.1 Background and Purpose

This transportation study has been undertaken for the New England Medical Center, Inc., Tufts/New England Medical Center, Inc., Asian Community Development Corporation (ACDC) and the Chinatown Economic Development Corporation (CEDC) to assess in a comprehensive way the transportation impacts of several projects in the South Cove area of downtown Boston (Figure 1.1 - Location Map) which will be implemented over the next ten years.

The New England Medical Center (NEMC) is in the midst of a ten year master planning effort which will guide the area's growth to the year 2000. An additional 252,000 square feet of floor space is proposed for development within this time frame. In the past ten years, the New England Medical Center area has grown and changed considerably, under constant scrutiny by community groups in neighboring Chinatown, South Cove, Bay Village and the South End, who wish to protect neighborhood interests as the institutions expand.

At the same time, both the Asian Community Development Corporation and the Chinese Economic Development Corporation have been pursuing plans for new housing on two redevelopment parcels. In addition, the Boston Redevelopment Authority has been working with the community to develop a community center on a third parcel. Each of these projects are expected to be implemented within the same time frame as that covered by the NEMC Master Plan.

Given the narrow streets and heavily used parking facilities in the area, a major concern is transportation for both current and new employees, patients and visitors. For this reason, the Boston Redevelopment Authority and the Boston Transportation Department have requested that a transportation study be conducted to cover both NEMC and community proposals. The study must also serve as part of the Environmental Impact Report (EIR) required by the Massachusetts Environmental Policy Act (MEPA) unit of the Executive Office of Environmental Affairs. Subsequent to "scoping sessions," through which the City agencies and MEPA outlined specific study requirements, the four organizations retained Howard/Stein-Hudson Associates as transportation consultants to carry out the required study.



LOCATION MAP

FIGURE 11

1.2 Description of Projects

The study covers the following specific projects, as shown in Figure 1.2 - Study Area and Proposed Development.

- NEMC Phase 1-C developments, as defined in the Master Plan. These proposals include 252,000 SF of new development providing 196 new beds in two buildings, along with research uses:

  - 1-C North: 171,025 square feet; and
  - 1-C South: 80,944 square feet.

  In addition, the emergency entrance of the hospital will be relocated from Harrison Avenue to Washington Street.

- To accommodate parking for the Phase 1-C project and replacement parking for spaces lost on Parcels A, B, and C, a reconstruction and expansion of the Herald Street Garage is also proposed.

- Housing on Parcel A, proposed by the Chinese Economic Development Council (CEDC) and known as Mei Wah Village, includes 141 rental units and 160 parking spaces.

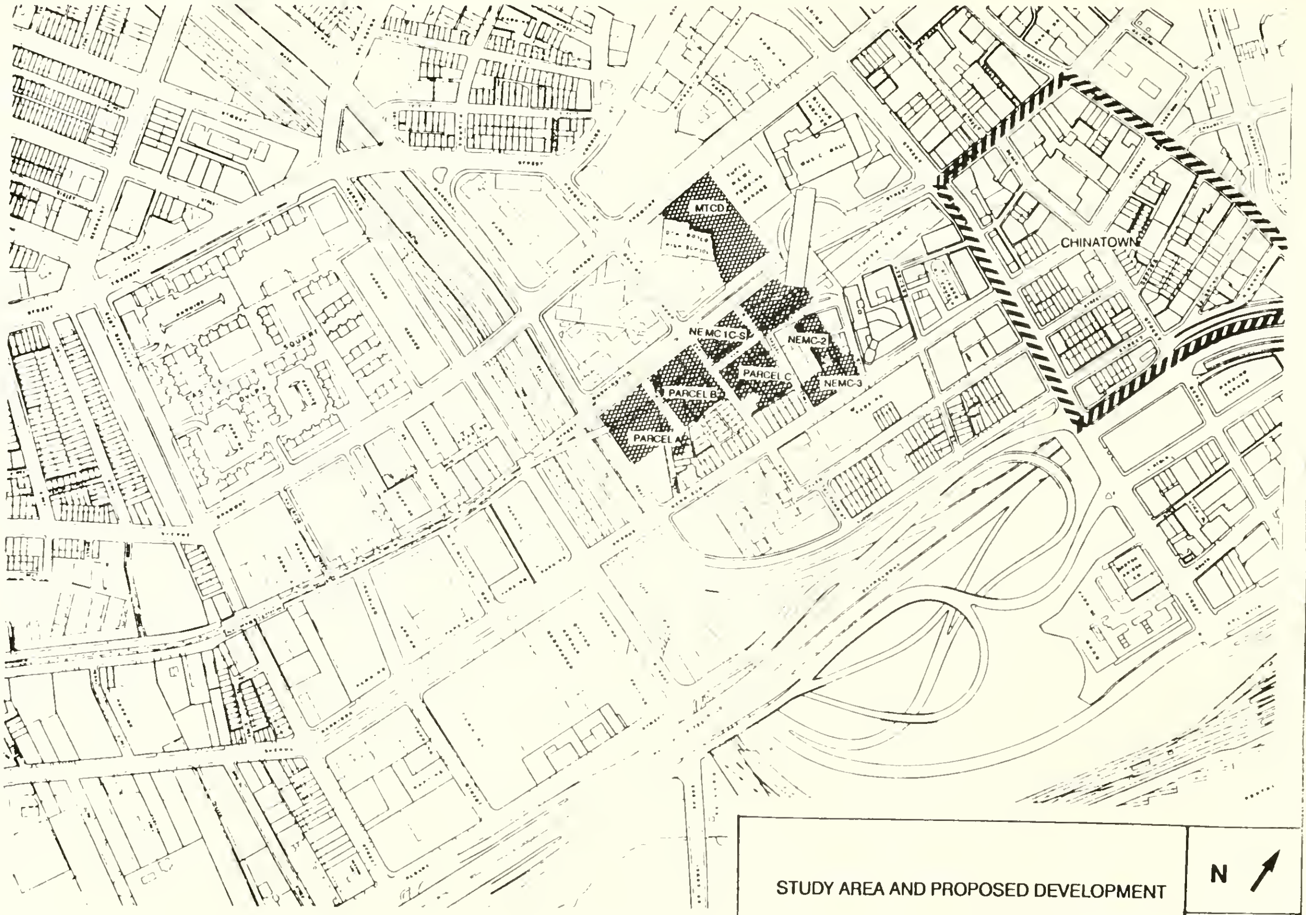
- Housing on Parcel B, proposed by the Asian Community Development Corporation (ACDC), includes 120 rental units and 90 parking spaces.

- A 90,000 square foot recreation center is proposed for Parcel C. No parking is proposed at this time.

To provide some context for the proposed NEMC development, it may be pointed out that the current NEMC establishment consists of 1,357,000 SF of hospital, research, and office/support uses. Thus, the 252,000 SF of new development covered by the EIR represents an increase of 18.6% in existing NEMC floor area. *Longer range NEMC development has been proposed, including Phase 2 and Phase 3 buildings, and a proposed Research Building, but these projects are not specifically analyzed in this report, as implementation is planned beyond the year 2000.*

1.3 Methodology and Data Sources

This study utilizes established transportation planning procedures to ascertain existing transportation conditions -- traffic, parking, transit and pedestrian -- in the study area. With this as a base, the impacts of the project and other likely developments in the general area by the year 2000 are estimated and added to the base case. Impacts are measured in



STUDY AREA AND PROPOSED DEVELOPMENT

FIGURE 1.2

terms of traffic Level of Service (LOS)/ capacity analyses, parking supply and demand, transit service sufficiency, and pedestrian conditions. Finally, measures for the mitigation of negative impacts are proposed.

In addition, to supplement and document existing traffic volume counts from available reports, peak period intersection turning movement traffic counts and 24-hour Automatic Traffic Recorder (ATR) counts were conducted in January through April of 1990. To document pedestrian conditions, AM and PM peak period and lunchtime peak hour counts were conducted in January, 1990. All count summaries are included in Appendix A.

To firmly establish travel characteristics, a survey of NEMC and Tufts employees, faculty, staff and students was conducted during February, 1990 to document existing travel patterns and to update survey data collected for NEMC in 1986 by Vanasse Hangen. Survey findings are discussed later in this report.

1.4 Report Organization

This report presents the study analyses and findings in the following sections:

2. Existing Conditions;
3. Future Trip Generation;
4. Impacts of Projects;
5. Mitigating Measures.

2.0 EXISTING CONDITIONS

2.1 Study Area

The study area and proposed projects are shown in Figure 1.2, above. For purposes of traffic analysis, a broad study area encompassing roadways used for access to and from the regional expressway system both from parking facilities north of the Massachusetts Turnpike and the fringe parking garage across the Turnpike on Herald Street was specified. The study area includes 27 intersections, as shown later in Figure 2.2 - Traffic Impact Area and Intersections Analyzed. Subareas were also defined for purposes of analyzing the individual housing developments and the community center on Parcels A, B, and C. These definitions will be discussed in Section 2.5, which describes the traffic levels of service analyses.

2.2 Demographic Profile

To give an indication of daily employee, visitor, and resident population within the study area, the following profile was developed through interviews with administrative personnel.

Floor Space

Floor space by use type for New England Medical Center and Tufts University is summarized in Table 2.1.

The New England Medical Center occupies 1,356,992 square feet of floor space in 18 facilities within the study area. The major inpatient facilities are the Proger, Pratt, Farnsworth, Floating Hospital, Rehab and Center Buildings, which account for 56% of total floor space. Each of these facilities also accommodates some office, research, and support space as well.

Table 2.1
Gross Floor Area by Institution

Institution/Building	1990 Gross Floor Area of Occupied Space	Primary Use
New England Medical Center		
Proger	221,579	Inpatient, labs, admin, offices, research, support
Pratt	51,766	Inpatient, ambulatory, admin, office, support
Farnsworth	104,044	Inpatient, ambulatory, admin, office, support
Floating	282,390	Inpatient, office, support,labs, admin
Biewend	145,564	Ambulatory care, office, admin, labs, support
Ziskind	100,955	Research, office, support, labs
Rehab	54,716	Inpatient, emergency,admin, office, research
Center	49,064	Inpatient, office, ambulatory, support
Boston Dispensary	46,386	Research, ambulatory, office, support, admin
MRI	12,667	Diagnostic services, research
Jackson	23,562	Administration
Common Services	15,039	Administration, support
Tupper (15 Kneeland)	110,510	Research and administration
35 Kneeland	103,565	Training, administration
Holmes	16,076	Administration
17 Nassau	5,587	Credit Union, Research Finance, and T/NEMC
Hemenway	10,450	Administration
Nursing Education	3,072	Nursing Education,. Classrooms
Total New England Medical Center:	**1,356,992**	
Tufts University		
M & V Building	124,301	Research & Teaching
Sterns Building	56,447	Research & Teaching
Arnold Building	57,381	Research & Teaching
South Cove Building	44,749	Research & Teaching
Dental Building	215,715	Teaching & Clinic
HNRC Building	204,430	Research
Sackler Building	134,817	Teaching & Administration
193 Harrison	5,560	Administration
203 Harrison	4,061	Administration
Posner	62,383	Administration & Dormitory
Total Tufts University:	**909,844**	

Tufts University occupies 909,844 square feet of floor space in 10 buildings, of which the largest are the Dental Building and the HNRC building. About 838,000 square feet is devoted to research and teaching, with the remaining space devoted to administration, and a dormitory in the Posner Building, which accommodates 96 students in single rooms.

Daily On-site Population and Employment

Estimates of daily population and employment for the Medical Center and Tufts University are provided in Table 2.2. As shown, the Tufts University Medical and Dental Schools attract around 3,500 students, faculty, clerical and support staff during the weekdays. Due to variations in weekly schedules, however, it is not likely that the maximum population of faculty and students would be on site at any one time. In addition, a small number of nurses and physical plant maintenance staff are present for the evening and night shifts.

At New England Medical Center, approximately 3,000 employees work a standard day shift. Another 400 work from 7:00 AM to 3:00 PM, 260 work from 3:00 PM to 11:00 PM, and 200, including nurses, on call residents, and physical plant staff, work from 11:00 PM to 7:00 AM.

Numerous other Chinatown neighborhood and citywide institutions contribute to the daytime population in the study area. Don Bosco High School accommodates 608 students and 52 staff each day. The Josiah Quincy Elementary School serves 75-100 half time kindergarten students and 700 elementary students. The Quincy School Community Council's human services programs for children and adults, Golden Age Center programs for the elderly, and South Cove Health Center bring 800 or more clients and others to the area each day, both on foot from nearby Chinatown and the South End, and from other areas.

Residential Population

Residential population in Chinatown[1] was over 5,100 in 1987[2], with a large propor

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[1] Defined by the Boston Redevelopment Authority as the area bounded by Essex Street, the Surface Artery, Stuart/Kneeland Street and Washington Street, as outlined in Figure 1.2

[2] Boston Redevelopment Authority. Kingston-Bedford-Essex Street Development Draft Environmental Impact Report, April, 1989.

Table 2.2

Tufts University and NEMC Daytime Population

Daily Population:

	Employees by Shift:						
Institution	Day	7-3	3-11	11-7	Faculty/ Physic.	Students	TOTAL
NEMC	3,000	400	260	200	0	0	3,860
Tufts Univ.	1,418	0	0	21	420	1,625	3,484
TOTAL	**4,418**	**400**	**260**	**221**	**420**	**1,625**	**7,044**

tion of "traditional, ethnic families that are less affluent," according to the BRA.[3] Chinatown is primarily home to first generation Chinese immigrants. Ninety one percent of the residents are Chinese, while two percent are Cambodian, Vietnamese, or other Asian nationalities.

In 1985, most Chinatown residents lived in rented dwelling units, and rents were still well below the Boston average. The housing stock is a mixture of older three to five story rowhouses, and ten or twenty story housing developments built during the urban renewal era. There are approximately 1,500 housing units in the neighborhood, nearly one-half of which are in large subsidized projects. Mass. Pike Towers has 850 tenants and 7 stff people; Quincy Towers has 175 tenants and 5 staff; Tai Tung Village has 214 units and 16 storefronts.

2.3 Travel Modes of Residents, Employees, Visitors, and Patients

Travel modes of the current population working in, living in, or visiting the study area were obtained from several sources, as described below.

Residents

Work trip travel patterns for existing residents of the area were obtained from the U.S. Census 1980 Journey to Work data compiled by the Central Transportation Planning Staff, the Boston region's transportation planning agency. Work trip characteristics were chosen as most characteristic of peak hour travel. These data, for traffic zone 53, showed that, of residents living in Zone 53:

- 9% drive alone and 25% travel in carpools, yielding an average auto occupancy of 2.1 persons/vehicle;
- 10% go to work by public transportation; and
- 56% go to work by walking, bicycle, taxi, motorcycle or other means.

This is a much lower auto use rate than for Boston neighborhoods as a whole, reflecting the low auto ownership rate in this neighborhood. In 1980, 67% of Chinatown households owned no cars; 31% owned one car, and 2% owned 2 cars. No households owned more than 2 cars. The high carpool rate is also of interest, probably reflecting the heavy use of vans to transport restaurant workers from Chinatown to other neighborhoods in Boston and other communities. Average car occupancy was 2.1 persons per vehicle, almost twice the average for other Boston neighborhoods.

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[3] Boston Redevelopment Authority. Draft: Central District Neighborhood Profile, 1988.

Visitors and Patients

Visitor and patient travel patterns for the NEMC were derived from surveys conducted by VHB in the 1986 Parking Needs and Site Evaluation Study. While this survey did not reflect the opening of the new Orange Line station at the Medical Center, it showed that:

- 60% of NEMC visitors came by auto;
- 29% used transit; and
- 11% walked or used other modes.

Employees

Through the City of Boston scoping meetings, it was determined that new data collection was necessary to update employee travel data to ascertain the effects of the new Orange Line station was necessary. Thus, a self-administered one-page survey was distributed to NEMC, Tufts and TNEMC employees in February, 1990.

Complete and valid surveys were received from 1,467 respondents. About 8,000 surveys were distributed, yielding a response rate of about 18%. This is more than adequate to identify existing travel patterns and modes to/from the area.

A comparison of the 1990 Howard/Stein-Hudson survey results to the Vanasse/Hangen survey of 1986 is presented in Tables 2.3, 2.4 and 2.5 for Mode Choice, Subway Riders by Station and Bus Riders by Route, respectively. Table 2.6 identifies the Trip Distribution for those traveling to/from the area by all modes.

Mode Choice - The survey results for mode choice (identified for employees, staff and students only and not visitors and patients) indicate that overall vehicle use within the medical area as a whole (NEMC plus Tufts population) has increased approximately 7%, from 46.4% to 53.2%. This increase is equally distributed between solo drivers and passengers in an auto (carpoolers). It also appears the walk and bicycle/motorcycle modes have decreased over the four year period and switched to auto mode. This minor shift could be a result of the season in which the surveys were conducted (May 1986 vs. February 1990).

While the 7% overall increase in vehicle use seems high, it is important to note that, if one views NEMC employees as a separate group, the comparative results for auto drivers were not significantly different. The percentage of drivers changed from 44.7% in the V/H survey to 47.2% in the more recent H/S-H survey. Comparison of the two survey groups indicates that this change of 2.5% is not statistically significant.

Table 2.3
Transportation Mode of NEMC Employees - 1986 and 1990

	V/H Survey: 1986						H/S-H Survey: 1990					
	NEMCH Staff		Tufts-Related		Total		NEMCH Staff		Tufts-Related		Total	
Mode	Freq	Prct.	Freq.	Prct.	Freq.	Prct.	Freq.	Prct.	Freq.	Prct.	Freq.	Prct
Drive	343	44.7%	80	28.0%	423	40.2%	523	47.5%	144	39.6%	667	45.7%
Passenger	15	2.0%	5	1.7%	20	1.9%	41	3.7%	21	5.7%	62	4.2%
Dropped Off	37	4.8%	9	3.1%	46	4.4%	40	3.6%	8	2.3%	48	3.3%
Total Auto	**395**	**51.5%**	**94**	**32.9%**	**489**	**46.4%**	**604**	**54.8%**	**173**	**47.6%**	**777**	**53.2%**
Subway	245	31.9%	120	42.0%	365	34.7%	341	31.0%	110	30.2%	451	30.9%
Bus	46	6.0%	9	3.1%	55	5.2%	63	5.7%	24	6.6%	87	6.0%
Comm. Rail	27	3.5%	9	3.1%	36	3.4%	64	5.8%	35	9.6%	99	6.8%
Comm. Boat	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.8%	3	0.2%
Total Transit	**318**	**41.5%**	**138**	**48.3%**	**456**	**43.3%**	**468**	**42.5%**	**172**	**47.2%**	**640**	**43.8%**
Taxi	4	0.5%	0	0.0%	4	0.4%	1	0.0%	0	0.0%	1	0.1%
Walk	29	3.8%	41	14.3%	70	6.6%	23	2.2%	8	2.2%	31	2.1%
Bicycle/ Motorcycle	13	1.7%	13	4.5%	26	2.5%	0	0.0%	6	1.6%	6	0.1%
Vanpool/ Carpool	8	1.0%	0	0.0%	8	0.8%	5	0.5%	5	1.4%	10	0.7%
TOTAL	**767**	**100.0%**	**286**	**100.0%**	**1053**	**100.0%**	**1101**	**100.0%**	**364**	**100.0%**	**1465**	**100.0%**

Table 2.4
Subway Riders by Station

STATION	V/H Survey 1986 Frequency	V/H Survey 1986 Percent	H/S-H Survey 1990 Frequency	H/S-H Survey 1990 Percent
ORANGE:				
Back Bay	na	0.0%	3	0.6%
NE Medical Ctr.	na	0.0%	363	68.0%
Chinatown	227	42.0%	3	0.6%
North Station	0	0.0%	1	0.2%
RED:				
Broadway	8	1.5%	5	0.9%
South Station	0	0.0%	24	4.5%
Downtown Crossing	83	15.4%	49	9.2%
Park Street	45	8.3%	15	2.8%
GREEN:				
Copley	3	0.6%	0	0.0%
Arlington	2	0.4%	0	0.0%
Boylston	167	30.9%	71	13.3%
BLUE:				
State	5	0.9%	0	0.0%
TOTAL	**540**	**100.0%**	**534**	**100.0%**

Table 2.5
Bus Riders by Route

	V/H Survey 1986		H/S-H Survey 1990	
MODE	Frequency	Percent	Frequency	Percent
Route 9	0	0.0%	4	6.5%
Route 11	36	53.7%	21	33.9%
Route 39	1	1.5%	0	0.0%
Route 43	1	1.5%	2	3.2%
Route 49	1	1.5%	6	9.7%
Route 55	2	3.0%	3	4.8%
Route 92	0	0.0%	1	1.6%
Route 93	1	1.5%	0	0.0%
Route 300	3	4.5%	4	6.5%
Route 301	10	14.9%	7	11.3%
Route 304	6	9.0%	5	8.1%
Route 305	6	9.0%	6	9.7%
Route 352	0	0.0%	2	3.2%
Route 441	0	0.0%	1	1.6%
TOTAL	**67**	**100.0%**	**62**	**100.0%**

Table 2.6
Regional Trip Distribution: Auto Drivers and Passengers

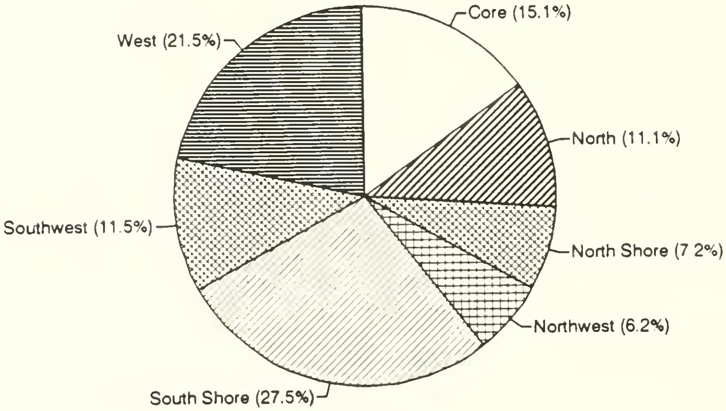
	DRIVE		PASSENGER		DROP OFF		TOTAL AUTO	
DIRECTION/CORRIDOR	Freq.	Prct.	Freq.	Prct.	Freq.	Prct.	Freq.	Prct.
CORE:								
Core	100	15.0%	4	6.5%	13	27.1%	117	15.1%
Subtotal	100	15.0%	4	6.5%	13	27.1%	117	15.1%
NORTH:								
NH/MA	23	3.4%	1	1.6%	0	0.0%	24	3.1%
North Inner	30	4.5%	2	3.2%	2	4.2%	34	4.4%
North Outer	23	3.4%	4	6.5%	1	2.1%	28	3.6%
Subtotal	76	11.4%	7	11.3%	3	6.3%	86	11.1%
NORTH SHORE:								
NH/ME/MA	11	1.6%	0	0.0%	2	4.2%	13	1.7%
North Shore Inner	13	1.9%	2	3.2%	2	4.2%	17	2.2%
North Shore Outer	17	2.5%	8	12.9%	1	2.1%	26	3.3%
Subtotal	41	6.1%	10	16.1%	5	10.4%	56	7.2%
NORTHWEST:								
Northwest Inner	17	2.5%	3	4.8%	0	0.0%	20	2.6%
Northwest Outer	23	3.4%	1	1.6%	1	2.1%	25	3.2%
Western MA North	3	0.4%	0	0.0%	0	0.0%	3	0.4%
Subtotal	43	6.4%	4	6.5%	1	2.1%	48	6.2%
SOUTH SHORE:								
Cape Cod	6	0.9%	1	1.6%	0	0.0%	7	0.9%
South Shore Inner	79	11.8%	5	8.1%	10	20.8%	94	12.1%
South Shore Outer	72	10.8%	5	8.1%	4	8.3%	81	10.4%
Southeast MA	29	4.3%	3	4.8%	0	0.0%	32	4.1%
Subtotal	186	27.9%	14	22.6%	14	29.2%	214	27.5%
SOUTHWEST:								
RI/MA	9	1.3%	2	3.2%	1	2.1%	12	1.5%
Southwest Inner	37	5.5%	7	11.3%	5	10.4%	49	6.3%
Southwest Outer	24	3.6%	2	3.2%	2	4.2%	28	3.6%
Subtotal	70	10.5%	11	17.7%	8	16.7%	89	11.5%
WEST:								
West Inner	80	12.0%	9	14.5%	2	4.2%	91	11.7%
West Outer	65	9.7%	3	4.8%	2	4.2%	70	9.0%
Western MA South	6	0.9%	0	0.0%	0	0.0%	6	0.8%
Subtotal	151	22.6%	12	19.4%	4	8.3%	167	21.5%
TOTAL	667	100.0%	62	100.0%	48	100.0%	777	100.0%

Table 2.7
Regional Trip Distribution: Transit Users

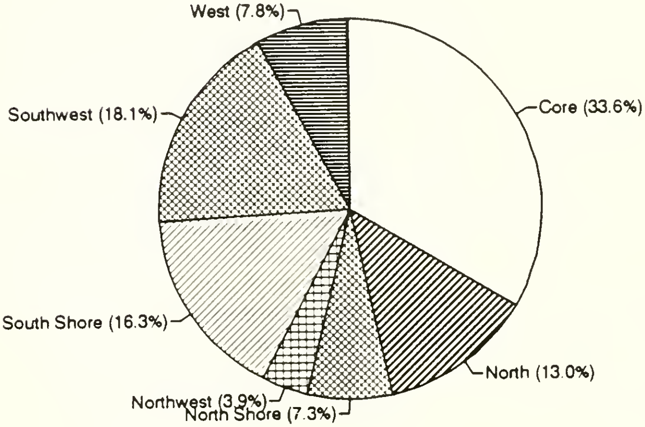
Direction/Corridor	Subway Freq.	Subway Prct.	Bus Freq.	Bus Prct.	Commuter Bus Freq.	Commuter Bus Prct.	Commuter Rail Freq.	Commuter Rail Prct.	Commuter Boat Freq.	Commuter Boat Prct.	Total Transit Freq.	Total Transit Prct.
CORE:												
Core	169	37.5%	43	53.8%	0	0.0%	3	3.0%	0	0.0%	215	33.6%
Subtotal	169	37.5%	43	53.8%	0	0.0%	3	3.0%	0	0.0%	215	33.6%
NORTH:												
NH/MA	4	0.9%	1	1.3%	0	0.0%	4	4.0%	0	0.0%	9	1.4%
North Inner	51	11.3%	0	0.0%	0	0.0%	4	4.0%	0	0.0%	55	8.6%
North Outer	13	2.9%	0	0.0%	0	0.0%	6	6.1%	0	0.0%	19	3.0%
Subtotal	68	15.1%	1	1.3%	0	0.0%	14	14.1%	0	0.0%	83	13.0%
NORTH SHORE:												
NH/ME/MA	3	0.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	0.5%
North Shore Inner	19	4.2%	0	0.0%	0	0.0%	1	1.0%	0	0.0%	20	3.1%
North Shore Outer	17	3.8%	1	1.3%	0	0.0%	6	6.1%	0	0.0%	24	3.8%
Subtotal	39	8.6%	1	1.3%	0	0.0%	7	7.1%	0	0.0%	47	7.3%
NORTHWEST:												
Northwest Inner	12	2.7%	1	1.3%	0	0.0%	0	0.0%	0	0.0%	13	2.0%
Northwest Outer	4	0.9%	2	2.5%	0	0.0%	4	4.0%	0	0.0%	10	1.6%
Western MA North	0	0.0%	0	0.0%	0	0.0%	2	2.0%	0	0.0%	2	0.3%
Subtotal	16	3.5%	3	3.8%	0	0.0%	6	5.1%	0	0.0%	25	3.9%
SOUTH SHORE:												
Cape Cod	1	0.2%	0	0.0%	3	42.9%	0	0.0%	0	0.0%	4	0.6%
South Shore Inner	53	11.8%	4	5.0%	0	0.0%	1	1.0%	0	0.0%	58	9.1%
South Shore Outer	23	5.1%	1	1.3%	1	14.3%	0	0.0%	3	100.0%	28	4.4%
Southeast MA	4	0.9%	6	7.5%	2	28.6%	2	2.0%	0	0.0%	14	2.2%
Subtotal	81	18.0%	11	13.8%	6	85.7%	3	3.0%	3	3.0%	104	16.3%
SOUTHWEST:												
RI/MA	2	0.4%	1	1.3%	1	14.3%	12	3.0%	16	2.5%	16	2.5%
Southwest Inner	54	12.0%	4	5.0%	0	0.0%	5	5.1%	0	0.0%	63	9.8%
Southwest Outer	5	1.1%	0	0.0%	0	0.0%	32	32.3%	0	0.0%	37	5.8%
Subtotal	61	13.5%	5	6.3%	1	14.3%	49	49.5%	16	2.5%	116	18.1%
WEST:												
West Inner	13	2.9%	14	17.5%	0	0.0%	3	3.0%	0	0.0%	30	4.7%
West Outer	4	0.9%	2	2.5%	0	0.0%	12	12.1%	0	0.0%	18	2.8%
Western MA South	0	0.0%	0	0.0%	0	0.0%	2	2.0%	0	0.0%	2	0.3%
Subtotal	17	3.8%	16	20.0%	0	0.0%	17	17.2%	0	0.0%	50	7.8%
TOTAL	451	100.0%	80	100.0%	7	100%	99	100.0%	3	100.0%	640	100.0%

Figure 2-1

REGIONAL TRIP DISTRIBUTION AUTO DRIVERS



REGIONAL TRIP DISTRIBUTION TRANSIT USERS



Auto occupancy for NEMC employees who said they had driven an auto to work was also about the same as that noted in the prior survey -- 1.09 on average as opposed to 1.08 in the prior survey. When overall auto occupancy for all who came by auto -- drivers, passengers and those who were dropped off -- is calculated, however, the average rises to 1.15 for NEMC employees and 1.2 for Tufts employees, with 1.16 the overall average.

Overall transit use has remained relatively constant from about 43.3% in 1986 to 43.8% in 1990. However, a 3% shift in mode share from transit to commuter rail has resulted, presumably due to the resumption of commuter rail service along the Needham Branch since the 1986 survey.

Subway Riders - As expected, the survey indicates a shift in subway station use to the New England Medical Center, with approximately 68% of all subway riders using this station. In addition, South Station exhibits an increase in usage. Subway stations that show a reduction in usage due to the survey responses include the Chinatown, Downtown Crossing, Park Street and Boylston stations.

Bus Riders - According to the survey results, bus ridership has increased insignificantly from 5.2% to 6.0%. The most heavily used bus route is Route 11 from South Boston. Route 49 from Roxbury and the South End has increased significantly since the Orange Line has been relocated. Other more heavily used bus routes include those express busses terminating in downtown such as Route 301 from Brighton, 305 from Waltham, 304 from Watertown and the 300 from Riverside.

Trip Distribution - Regional trip distribution identified in the survey results is presented in Table 2.6 for auto drivers and passengers and Table 2.7 for transit riders. These percentages are summarized in Figure 2-1. As shown, the primary corridor for auto drivers is the South Shore, accounting for 27.5% of auto drivers and passengers. The West corridor accounts for 21% of auto users. In contrast, about a third of transit riders come predominantly from the core area, comprising most of Boston, Brookline, and Cambridge. Eighteen percent come from the Southwest (good Orange Line and commuter rail access), and 16% from the South Shore (Red Line access).

2.4 Street Network and Circulation

The traffic impact study area and intersections identified for analysis are presented in Figure 2.2.

As shown, 27 intersections have been included in the study area, covering the medical area itself, and the primary fringe parking garage on Herald Street. The intersections include the major entry and exit points from the Southeast Expressway and Massachusetts Turnpike.

2.5 Traffic Volumes

Average daily traffic volumes for the study area are shown in Figure 2.3. AM and PM peak hour volumes are shown in Figure 2.4 and 2.5. As shown, average daily traffic is heaviest on major arterials serving the expressway system such as Frontage Road, Albany Street, E. Berkeley Street, and Herald Street. Other arterials such as Stuart/Kneeland, Tremont Street, Marginal Road, and Washington Street serve moderate volumes. Streets internal to the Medical Area -- Harrison Ave., Tyler Street, Oak Street, Hudson Street -- serve low traffic volumes.

In the peak hours, the heaviest traffic flows occur along the expressway access routes, primarily along major arterials; i.e., the Stuart/Kneeland Street corridor, Albany Street, Frontage Road, Herald Street, Marginal Road, and E. Berkeley Street.

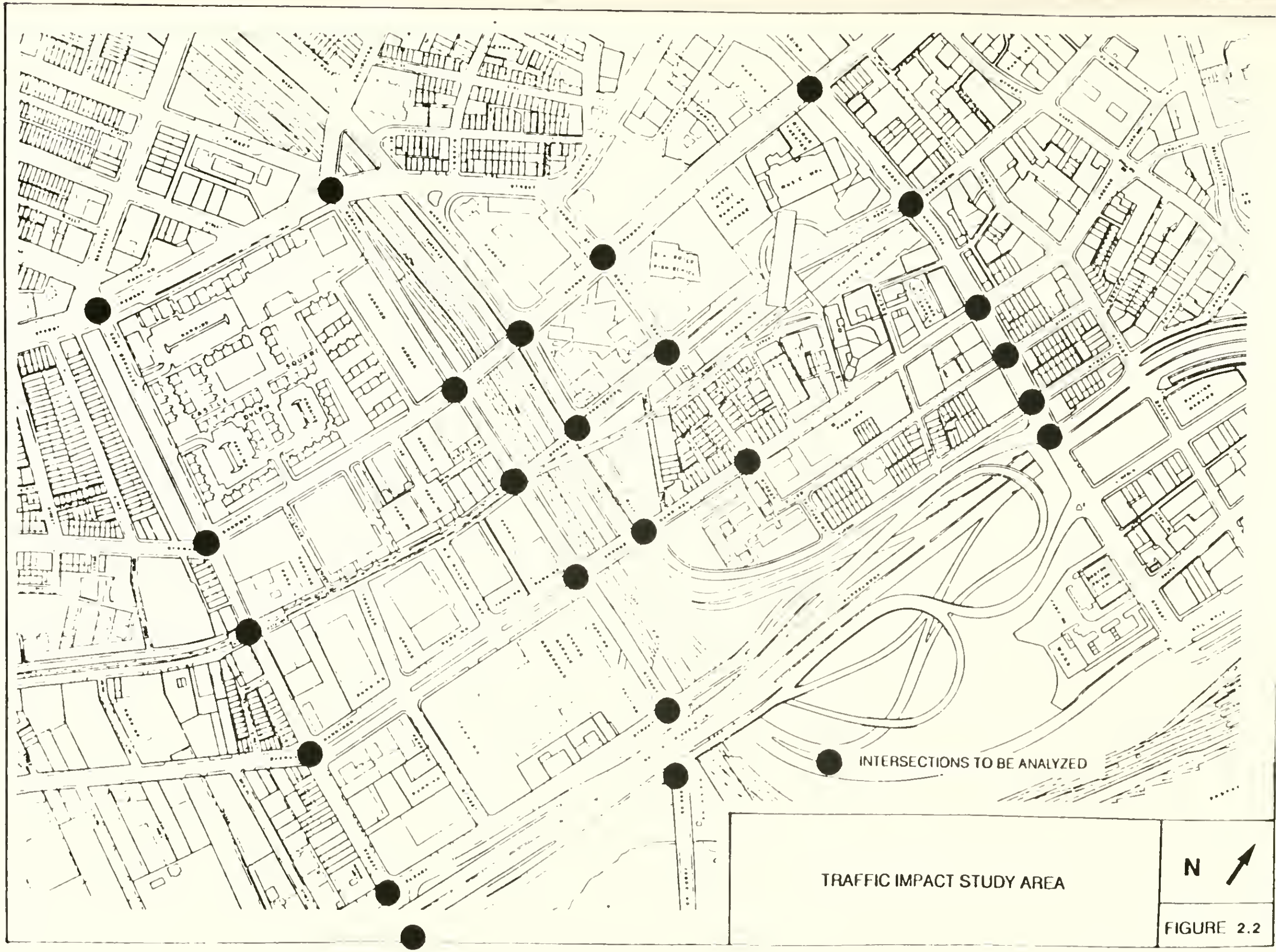
2.6 Traffic Level of Service (LOS) Analysis

Evaluation of the operating conditions at the 27 analysis intersections was made through Level of Service (LOS) calculations in the traffic peak hours. A fuller description of the LOS analyses, done in conformance with the "Highway Capacity Manual", is given in the Appendix. In brief, LOS are defined in the range of A to F, from best to worst, representing levels of average delay per vehicle (less than 5 seconds for A, greater 60 seconds for F). LOS A indicates little or no delay, with practically all traffic clearing a signal on the same cycle (green-red-green sequence) in which it arrives. At lower LOS, delays increase, with higher proportions of traffic having to wait for the next or subsequent cycles. LOS D is considered satisfactory for urban conditions. The capacity, or maximum number of vehicles which can pass through an intersection, is experienced at LOS E, short of LOS F, or flow breakdown conditions. Capacity is generally expressed as a volume to capacity ratio (V/C ratio), with values greater than one generally corresponding to LOS F.

Intersection levels of service are shown under existing (1989) conditions in Table 2-8.

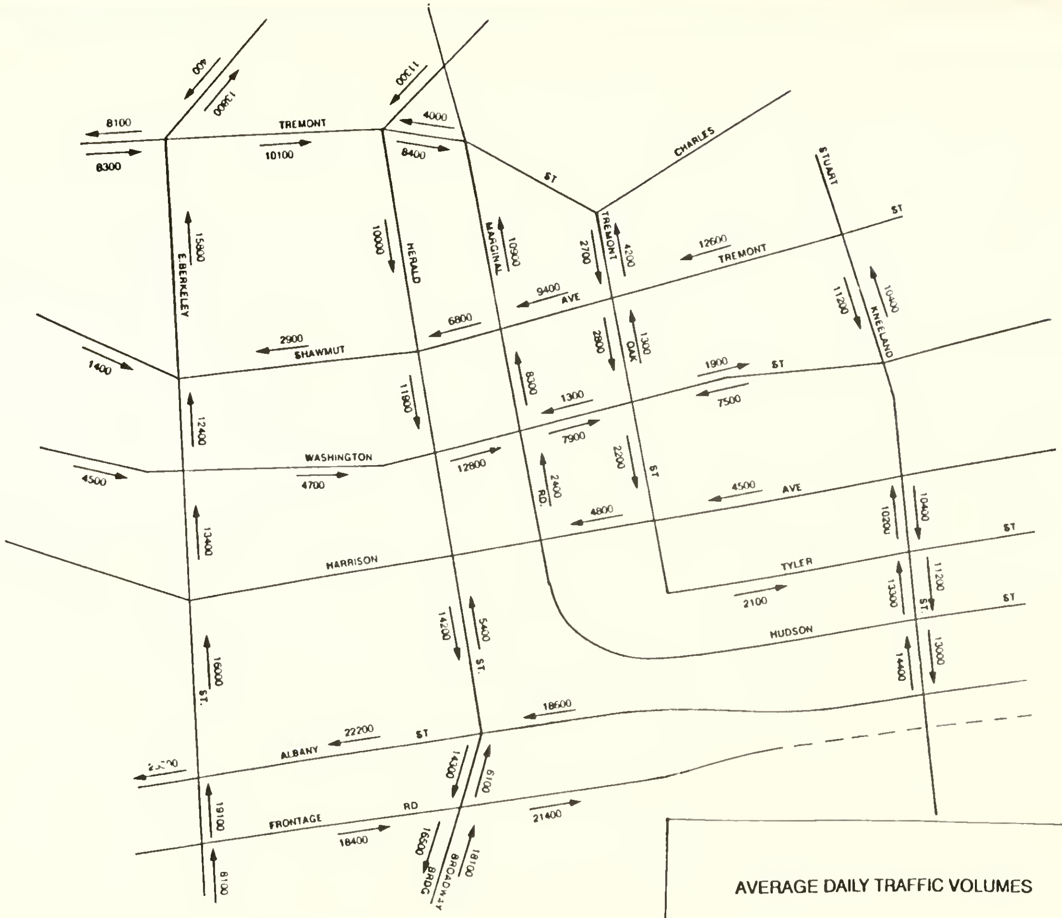
As shown, only two intersections operate at unacceptable conditions (worse than LOS D). These deficient conditions occur during the morning peak hour (7:45 to 8:45 AM) and are located within the Central Artery/Tunnel project boundaries at the intersections of Herald/Frontage/Broadway Bridge and East Berkeley/Frontage/W. Fourth St. Bridge. During the morning peak hour, all other intersection locations operate at or above LOS C.

During the evening peak hour (4:30 to 5:30 PM), no intersection in the study area operates below LOS D. Those locations at LOS D are limited to locations along the Kneeland Street and Herald Street corridors, and include: Kneeland/Harrison, Kneeland/Surface Artery, Herald/Albany, and Herald/Frontage Road/Broadway Bridge.



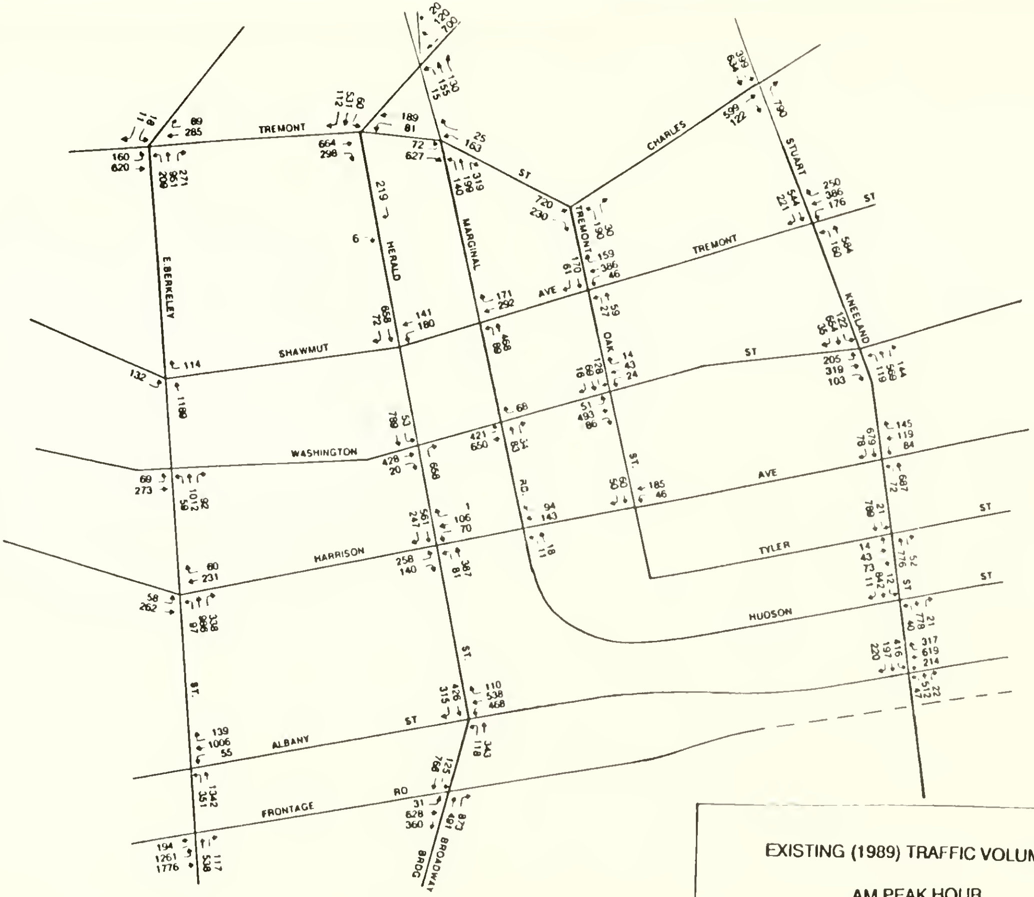
TRAFFIC IMPACT STUDY AREA

FIGURE 2.2



AVERAGE DAILY TRAFFIC VOLUMES

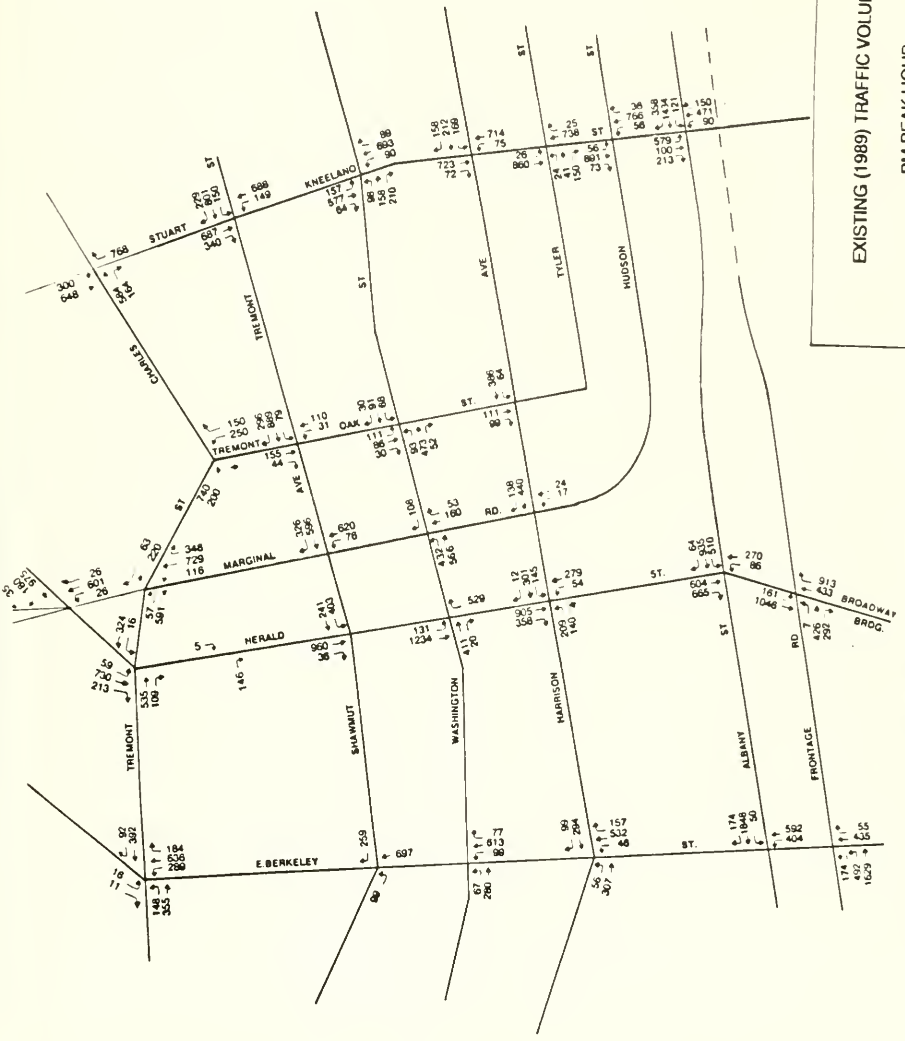
FIGURE 2.3



EXISTING (1989) TRAFFIC VOLUMES

AM PEAK HOUR

FIGURE 2.4



EXISTING (1989) TRAFFIC VOLUMES

PM PEAK HOUR

FIGURE 2.5

Table 2-8
Existing (1989) Intersection Levels of Service
In New England Medical Center Study Area

	AM Peak Hour			PM Peak Hour		
Location	LOS	Average Delay	V/C	LOS	Average Delay	V/C
Stuart/Tremont	B	11 sec	0.71	B	12 sec	0.84
Kneeland/Washington	B	12 sec	0.64	B	9 sec	0.68
Kneeland/Harrison	B	15 sec	0.70	D	29 sec	0.97
Kneeland/Tyler	B	7 sec	0.54	B	10 sec	0.80
Kneeland/Hudson	B	10 sec	-	C	14 sec	-
Kneeland/Surf. Art.	C	16 sec	0.81	D	33 sec	1.01
Oak/Tremont	B	8 sec	0.27	B	8 sec	0.52
Oak/Washington	B	10 sec	0.51	B	11 sec	0.56
Oak/Harrison	A	3 sec	-	A	3 sec	-
Marginal/Arlington	B	7 sec	0.25	B	9 sec	0.46
Marginal/Tremont	B	10 sec	0.59	B	11 sec	0.69
Marginal/Shawmut	B	9 sec	0.38	B	11 sec	0.61
Marginal/Washington	A	3 sec	0.37	B	5 sec	0.36
Marginal/Harrison	A	4 sec	0.13	A	3 sec	0.28
Herald/Tremont	B	11 sec	0.52	B	10 sec	0.47
Herald/Shawmut	B	10 sec	0.40	B	12 sec	0.65
Herald/Washington	B	10 sec	0.60	B	10 sec	0.61
Herald/Harrison	B	10 sec	0.59	B	12 sec	0.79
Herald/Albany	B	14 sec	0.69	D	27 sec	0.99
Herald/Frontage & Broadway	F	78 sec	1.22	D	39 sec	1.10
E.Berkeley/Tremont	C	15 sec	0.82	B	13 sec	0.58
E.Berkeley/Shawmut	B	6 sec	0.41	B	9 sec	0.39
E.Berkeley/Washington	B	8 sec	0.50	B	9 sec	0.39
E.Berkeley/Harrison	B	10 sec	0.67	B	10 sec	0.49
E.Berkeley/Albany	B	14 sec	0.75	B	14 sec	0.72
E.Berkeley/Frontage & W. 4th	F	72 sec	1.20	B	12 sec	0.83

LOS D is considered an acceptable traffic operating condition in urban areas, although it represents a good indicator of locations where additional traffic might cause traffic operational deficiencies.

2.7 Parking Conditions

Off Street Parking Supply

Existing off-street parking supply within the Medical Area is shown in Figure 2-6 and Table 2-9. As shown, total off-street parking supply is 2,888 spaces, of which 1,805 spaces in six lots and garages are reserved for NEMC patients, employees, and visitors. Of these, the 930 space Tremont Street Garage is open to the public from 5:00 PM to 7:00 AM, serving the theater district for evening performances and overnight parking needs in the area. Of the remaining 1,083 spaces, 651 spaces (60%) are open to the public, and 432 spaces (40%) are private. Parking is generally well occupied throughout the day, with the peak hour for the NEMC facilities occurring at around 1:00 PM. About 2,600 parkers use the NEMC facilities during an average weekday, as shown below:

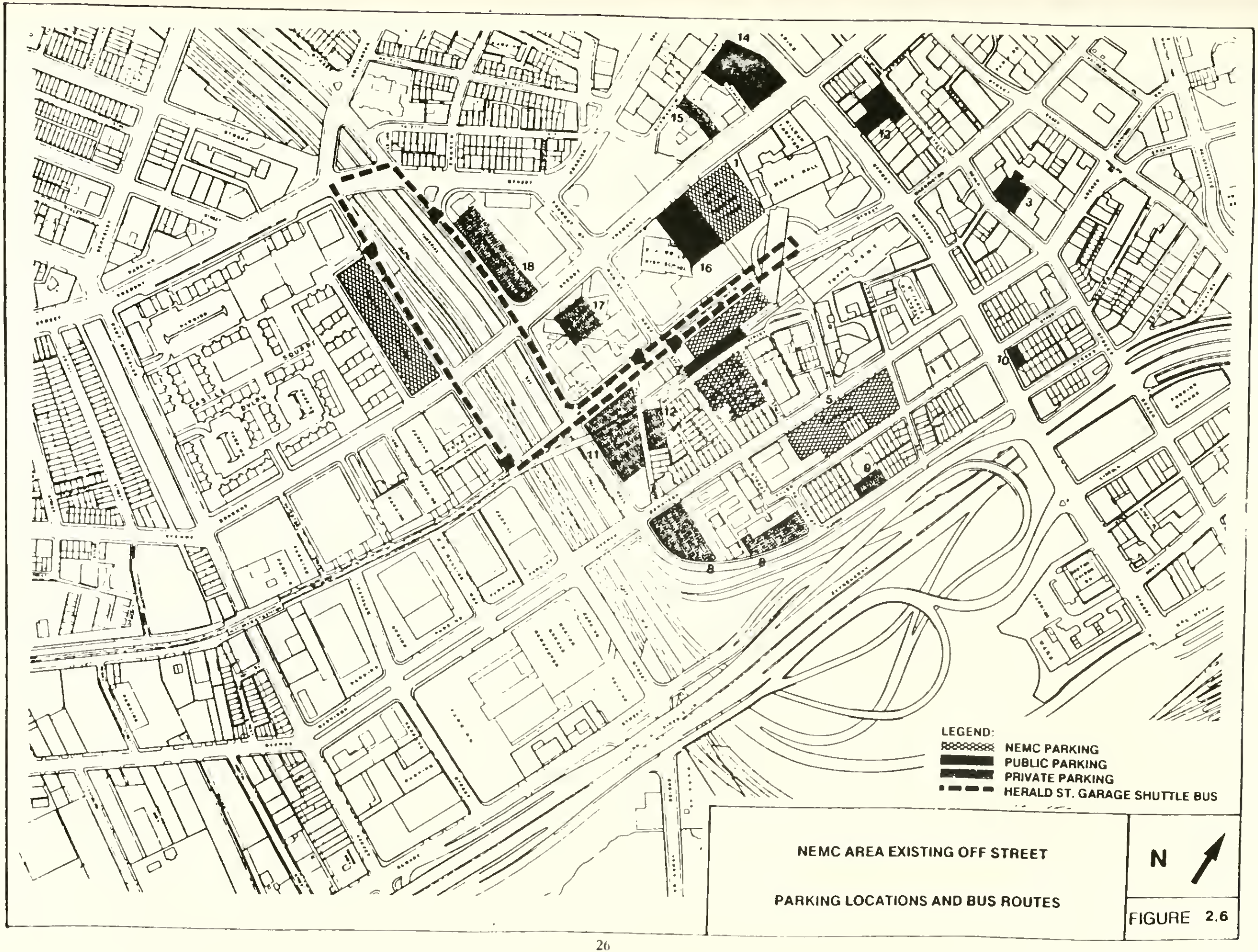
Type of Parker	Number	Percent
Monthlies (staff)	497	19%
Other employees	1,032	39%
Students	149	6%
Patients/visitors	954	36%

As shown, medical center staff account for almost 60% of total parkers, and patients and visitors 36%. Students account for a modest 6% of total daily parking activity.

Parking patterns for the various types of users are described in more detail below.

NEMC Patient/Visitor Parking

Two facilities -- the Harrison Avenue Lot and the Tremont Street Garage -- are primarily used for NEMC patient/visitor parking, each of which also provides some monthly employee parking (see below). Harrison Avenue serves an average of around 400 patients and visitors per day in addition to around 50 monthly parkers. The Tremont Street Garage serves about 550 patients and visitors per day, in addition to 800 employees.



NEMC AREA EXISTING OFF STREET

PARKING LOCATIONS AND BUS ROUTES

FIGURE 2.6

Table 2.9

Off-Street Parking In Study Area

Facility Name	Total Spaces	NEMC Spaces	Public Spaces	Private Spaces	Hours	Spaces Full at 1:00 PM
1. Tremont Street Garage	930	930 (days)	930 *	0	24 hours/day, 7 days/wk	930
2. Herald Street Garage	400	400	0	0	6am-1am M-F	400+
3. Beach Street Garage	490	150	340	0	24 hours/day, 7 days/wk	200 - NEMC 100 - other
4. Oak Street lot	72	72	0	0	5am-5:30pm, M-F	85
5. Harrison Avenue Lot	193	193	0	0	6:30am-11pm, M-Sat, 12-11PM Su.	180
6. Washington Street lot	60	60	0	0	1pm-12am, M-F	15
7. Ash Street lot	47	0	47	0	Unrestricted	47
8. Tai Tung Village lots						
Hudson at Tai Tung	44	0	0	44	Resident	43
Hudson at Harrison	57	0	0	57	Resident	40
9. Chinese YMCA lot	25	0	0	25	Member	19
10. Carlos Park and Go	20	0	0	20	7am-4pm, M-Sat.	18
11. Teradyne lot	93	0	0	93		57
12. Pine Street lot	20	0	0	20	(South Cove)	8
	18	0	0	18	(Teradyne)	6
13. Fitz Inn/Pay Rate lot	89	0	89	0	7am-12am, M-Sat, 12-8 pm Sun	89
14. Back Bay Auto Parks	95	0	95	0	8am-12am, 7 days	95
15. Tremont House lot	35	0	0	35	Valet	35
16. Tremont Auto Parks	80	0	80	0	8am-12am M-Sat, Noon-12am Sun.	80
17. Quincy School gar.	28	0	0	28	School hours	20
18. Mass Pike Tower lot	92	0	0	92	Resident	46
Total	**2888**	**1805**	**651**	**432**		**2513**

* 930 spaces in Tremont St. Garage are open to the public from 5:00 PM to 7:00 AM to serve theater district, etc.

The parking rate structure for patients and visitors with validated tickets is the same at both facilities, namely :

- Half hour:	$1.50
- One hour:	$2.50
- One and 1/2 hours:	$3.25
- Two hours:	$4.00
- Each additional 1/2 hour:	$0.50
- Maximum (24 hours):	$7.00

A rate of $12 per day is charged for those who do not obtain NEMC patient/visitor validation. This high rate is directed at prohibiting those who are not affiliated with NEMC from from parking in the facilities.

NEMC Employee and Student Parking

NEMC employees and students are assigned various types of parking stickers which allow parking at specific facilities, as follows.

- First, around 600 monthly employee passes are issued, as follows:

- Harrison Avenue lot ($85/month)--	56 passes
- Herald Street Garage ($60/month) --	24 passes
- Tremont Street Garage ($105/month) --	307 passes
- Oak Street Lot -- ($75/month)--	35 passes
- Beach Street Garage ($60/month)--	177 passes

On an average day, there are about 500 monthly parkers actually present at these facilities, or about 83% of the number of stickers issued. Priority at the Tremont Street Garage is assigned to "hands on" doctors, nurses and faculty members. The Tremont Street Garage also accommodates most of the second shift medical staff.

In addition, 2000 yellow "prime time" stickers are issued to other staff for parking at the other facilities on a "first come first served" basis. These allow parking at all facilities if spaces are available. These stickers enable parking for a cost of $4.50 per day at Tremont Street, $3.50 per day at Oak Street and $3.00 per day at Herald Street.

About 800 maroon student stickers allow parking for $2.50 per day only at Herald Street, if spaces are available. Of the 2,800 yellow and maroon stickers, about 1,181, or 42%, actually park in NEMC facilities on an average day, reflecting both the variable schedules of students and part-time staff, and also the fact that some parkers are turned away if no space is available.

Gray employee stickers allow parking for $3.00 at the Herald Street garage or for $4.50 at Tremont Street in the evening hours only. Weekend employee parking at Tremont Street is also available for $1.00 with these stickers.

Finally, parking for second shift NEMC employees only is allowed at the Washington Street lot for $3.50 per day. No stickers are used at this lot, because usage is controlled through the hours of operation. This lot is only open from 1:00 PM to 12:00 AM Monday through Friday.

Employees and students who arrived by auto were questioned about parking locations of the vehicle driver in the survey conducted for this study. The results are shown in Table 2-10, below.

Table 2-10
Employee and Student Parking Supply

Employee/Student Parking Location	Number	Percent
Tremont Street Garage	318	42.0%
Herald Street Garage	188	24.9
Oak Street lot	62	8.2
Harrison Avenue lot	62	8.2
40 Beach Street Garage	58	7.7
On-street	40	5.3
Washington Street lot	18	2.4
Other Garage/lot	10	1.3
Total Responses	**756**	**100.0%**

As shown, about two-thirds of the respondents parked at the Tremont Street or Herald Street garages. Forty two percent of the respondents parked in the Tremont Street Garage, followed by Herald Street, where 25% parked. Of the total, about 7% parked on-street or in other lots and garages in the area not controlled by NEMC. This number is down from a rate of 13% on-street or in non-NEMC facilities reported by Vanasse-Hangen in the 1986 survey.

Public Parking

Public parking rates at the various lots and garages vary from $2 to $6 for the first hour, and from $7 to $16 for all-day. The average first hourly rate is $4.32 and the average all day rate is $12.29. These rates are comparable with those charged elsewhere in the southern portion of downtown Boston.

On-Street Parking

On-street parking conditions are summarized in Tables 2-11 and 2-12 and Figure 2-7. As shown, there are a total of 456 legal on-street parking spaces in the study area. Of these, 131 spaces or 30% of the supply are restricted to resident parking only. Of the remaining 325 spaces, the following restrictions apply, as shown in Table 2-11, below:

Table 2-11
On-Street Parking Restrictions

	Type of Parking	Spaces	% of Total Supply
-	Metered parking:	209	46%
-	Unrestricted parking:	30	6%
-	Handicapped parking:	15	3%
-	Metered, but No Parking from 7-9:30 AM and 4-6 PM:	61	13%
-	Unrestricted, but No Parking from 7-9:30 AM and 4-6 PM:	10	2%
	Total non-resident	325	70%
	Resident Parking Only	131	30%
	Total on-street spaces	456	100%

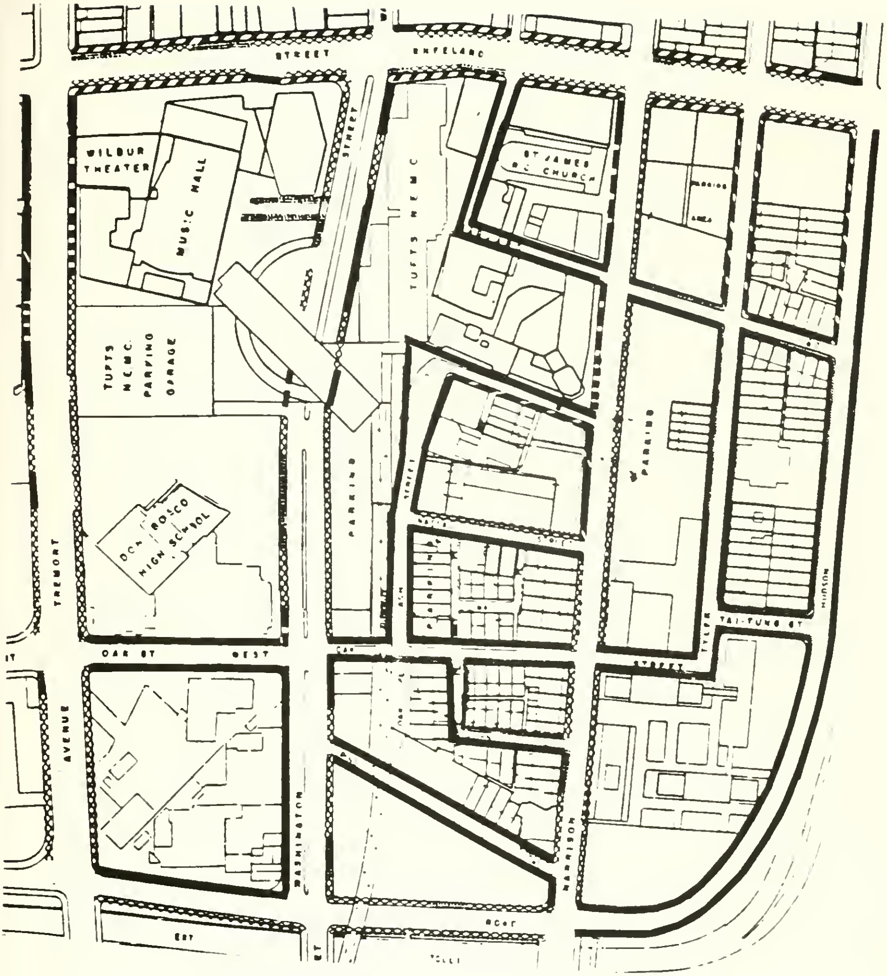
On-street parking spaces are summarized by type and location in Table 2-12.

2.8 Transit Service

The study area is well served by MBTA bus, rapid transit and commuter rail services, as shown in Figure 2-8. The most convenient station to the medical area is Tufts/New England Medical Center station on the Orange Line, with its entrance adjacent to the Floating Hospital on Washington Street. This station on the new Orange Line brought a station directly into the medical area, where none had existed before. Boylston Station on the Green Line is about 1/4 mile from the hospital, and the Chinatown station on the Orange Line is about 1,000 feet away. Washington Station serves the Red Line, and

Table 2-12
On-Street Parking in Study Area

Street	Metered Pkng.	Un-restr. Pkng.	HP Pkng.	Metered but NP 7-9:30 AM & 4-6 PM	Unrestr. but NP 7-9:30 AM & 4-6PM	Resi-dent Pkng.	Total Non-Resident Pkng.	Total Resident Pkng.	Total Parking Spaces
Kneeland St.	0	0	0	61	10	0	71	0	71
Harvard St.	0	8	0	0	0	8	8	8	16
Nassau St.	15	0	0	0	0	0	15	0	15
Tai-Tung St.	0	0	0	0	0	14	0	14	14
Oak St.	0	0	0	0	0	37	0	37	37
Johnny Ct. & Maple Place	0	0	0	0	0	13	0	13	13
Marginal Rd.	42	2	0	0	0	0	44	0	44
Tremont St.	43	2	4	0	0	0	49	0	49
Washington St.	50	16	2	0	0	0	67	0	67
Harrison Ave.	59	3	9	0	0	0	171	0	71
Tyler St.	0	0	0	0	0	45	0	45	45
Hudson St.	0	0	0	0	0	14	0	14	14
Total	**209**	**30**	**15**	**61**	**10**	**131**	**325**	**131**	**456**



LEGEND:

		TOTAL SPACES
Unrestricted Parking	▨	30
No Parking 8 am-6 pm	▬ ▬ ▬	
No Stopping 7-9:30 am, 4-6 pm	╱╱╱╱	
No Parking Any Time ,	━━━	
Handicap Parking Only	■■ ■■ ■■	15
Cab Stand	■■■■■■	
Reserved for Ambulance	▰▰▰	
Metered Parking	××××××	209
Resident Parking	▬▬▬	131
Metered Parking, but No Stopping 7-9:30 am, 4-6 pm	××╱╱	61
Unrestricted Parking, but No Stopping 7-9:30 am, 4-6 pm	▨╱╱	10

HOWARD/STEIN-HUDSON ASSOCIATES

NEW ENGLAND MEDICAL CENTER AREA

EXISTING ON STREET PARKING REGULATIONS

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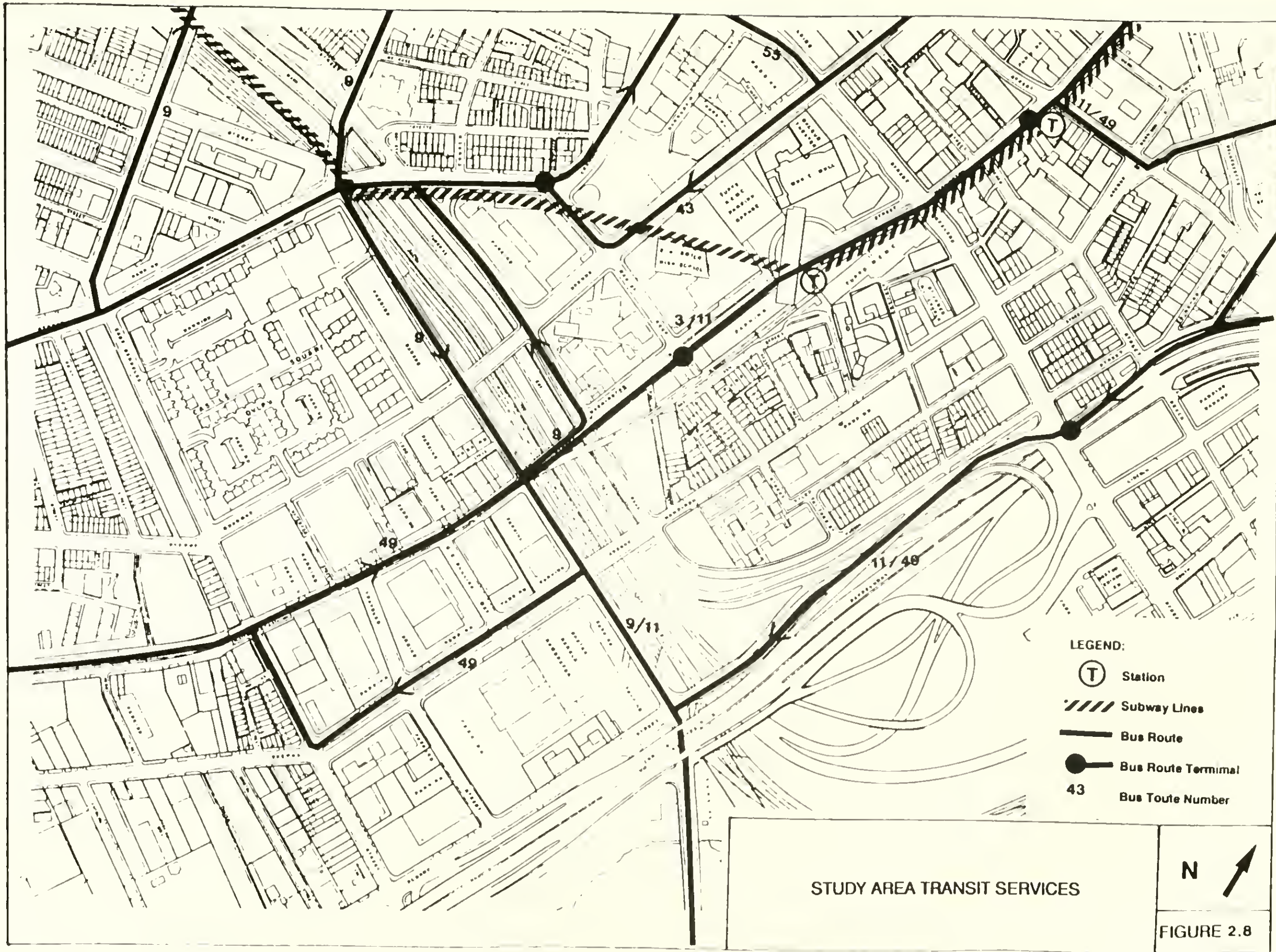
Figure 2.7



STUDY AREA TRANSIT SERVICES

FIGURE 2.8

South Station, within walking distance, serves commuter rail passengers. Commuter rail riders from the north can connect to the Orange Line at North Station for service to the study area. Local MBTA bus routes serving the study area include Routes 9 and 11 from South Boston, Route 43 from Roxbury, and Route 49 from the South End. Intercity buses stop at the Greyhound terminal at Arlington Street and St. James St. in the Back Bay and at the Trailways Terminal near South Station, both of which are within -- mile of the medical area.

2.9 Pedestrian Conditions

To establish existing pedestrian conditions and flow patterns, surveys and counts were conducted during March, 1990 in the Washington Street and Harrison Avenue corridors from Kneeland Street to Marginal Road, and in the vicinity of the Herald Street garage. Pedestrian conditions are summarized in Figure 2-9. Count summaries are included in Figures 2.10 and 2.11. Detailed pedestrian count summaries are included in Appendix E. As shown, the heaviest peak hour volumes, both morning and evening, occur in the vicinity of the MBTA station entrance on Washington Street, and in the block which extends from Oak Street to Kneeland Street. The heaviest station moves occur in the crossing of Washington Street at the entrance, with 664 pedestrians leaving the station in this direction in the morning and 287 entering from this direction in the evening. Other crossing and midblock volumes fall into the "low to moderate" range as defined by the Institute of Transportation Engineers, with "low" volumes defined as under 200 pedestrians per hour, moderate as 200-400, and high, 600 and over.[4]

The general condition of sidewalks on both Washington Street and Harrison Avenue is good. Sidewalks adequately accommodate the existing volumes of pedestrians making pedestrian/pedestrian conflicts nonexistent. Obstacles on the sidewalks are few, with most impediments consisting of small broken patches of sidewalk.

The condition of sidewalks on side streets is less favorable. For example, Pine Street has a dirt sidewalk on the south side and a narrow two foot sidewalk on the north side. Pedestrians often use the street instead of the sidewalks. Foot and car traffic on Pine Street is minimal, so that the situation of pedestrian and autos sharing the street does not present an obvious conflict in this instance.

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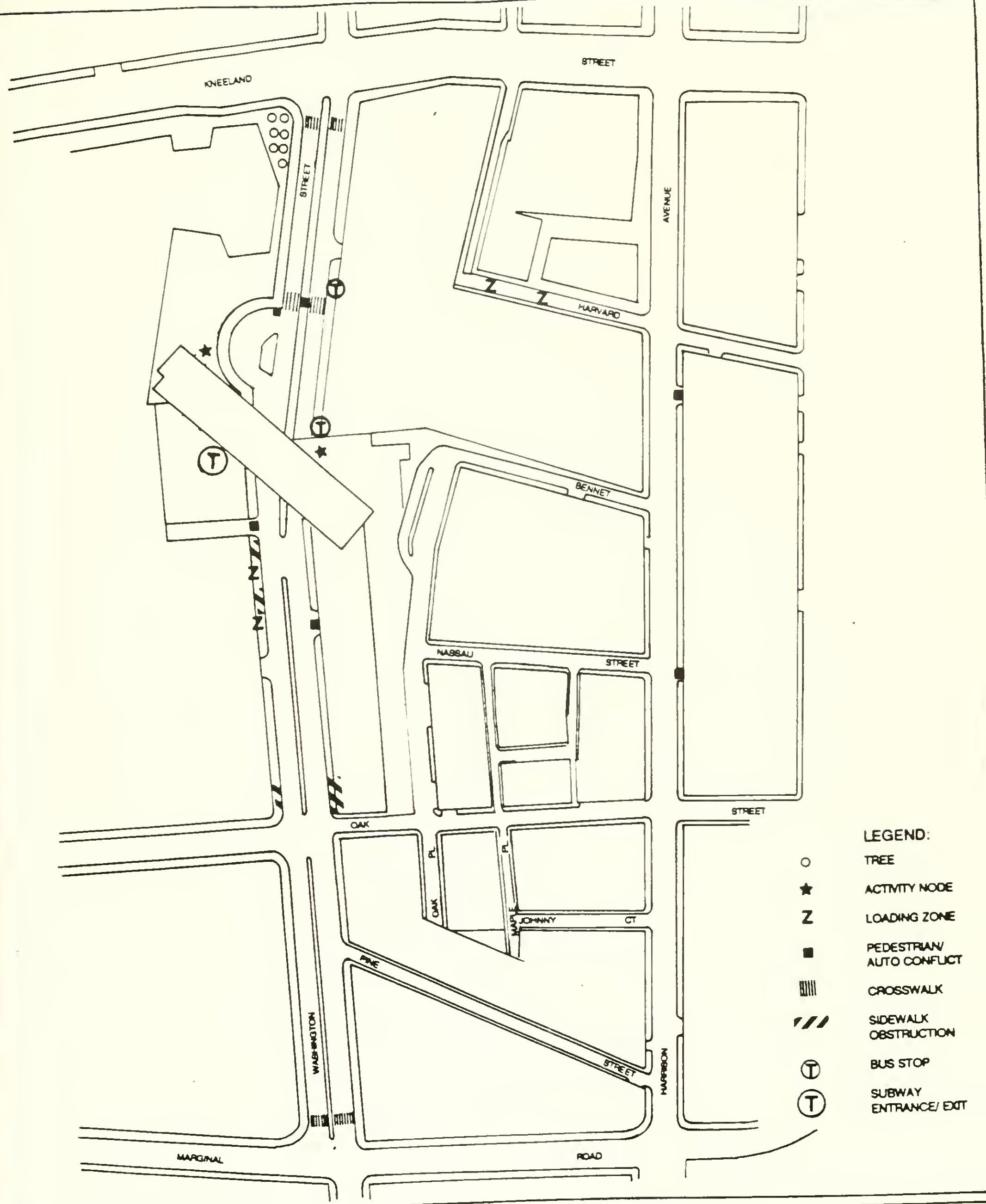
[4] This definition applies to analysis of conflicting pedestrian movements in conducting intersection traffic capacity analysis, as outlined in the Highway Capacity Manual, Special Report 209, Transportation Research Board, Washington, D.C., 1985. Analysis of actual pedestrian facility capacity is a function of the relationships of the pedestrian volumes to effective walkway width, once obstructions are taken into account.



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SURVEY OF PEDESTRIAN CONDITIONS

NEW ENGLAND MEDICAL CENTER AREA

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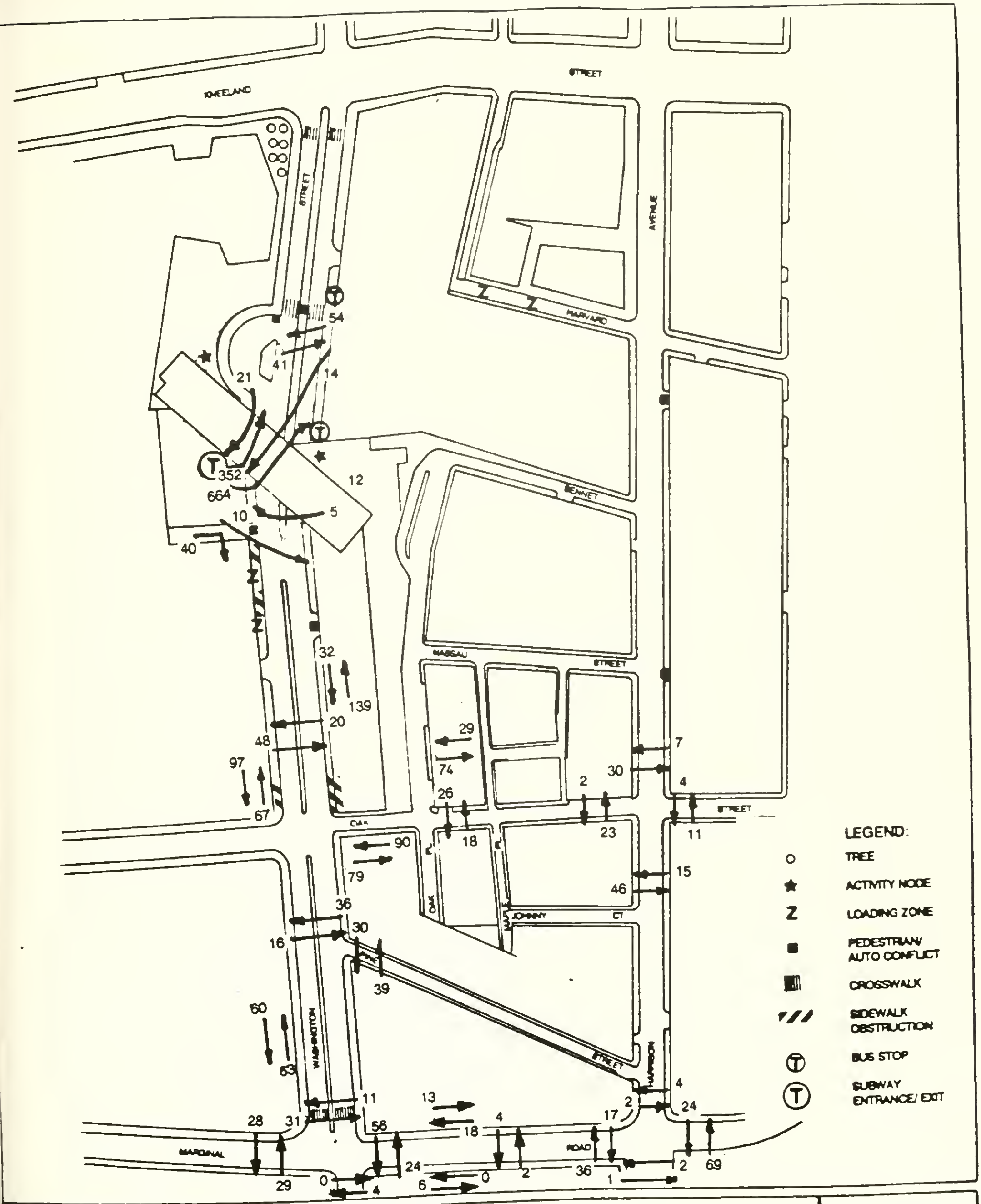
Figure 2.9



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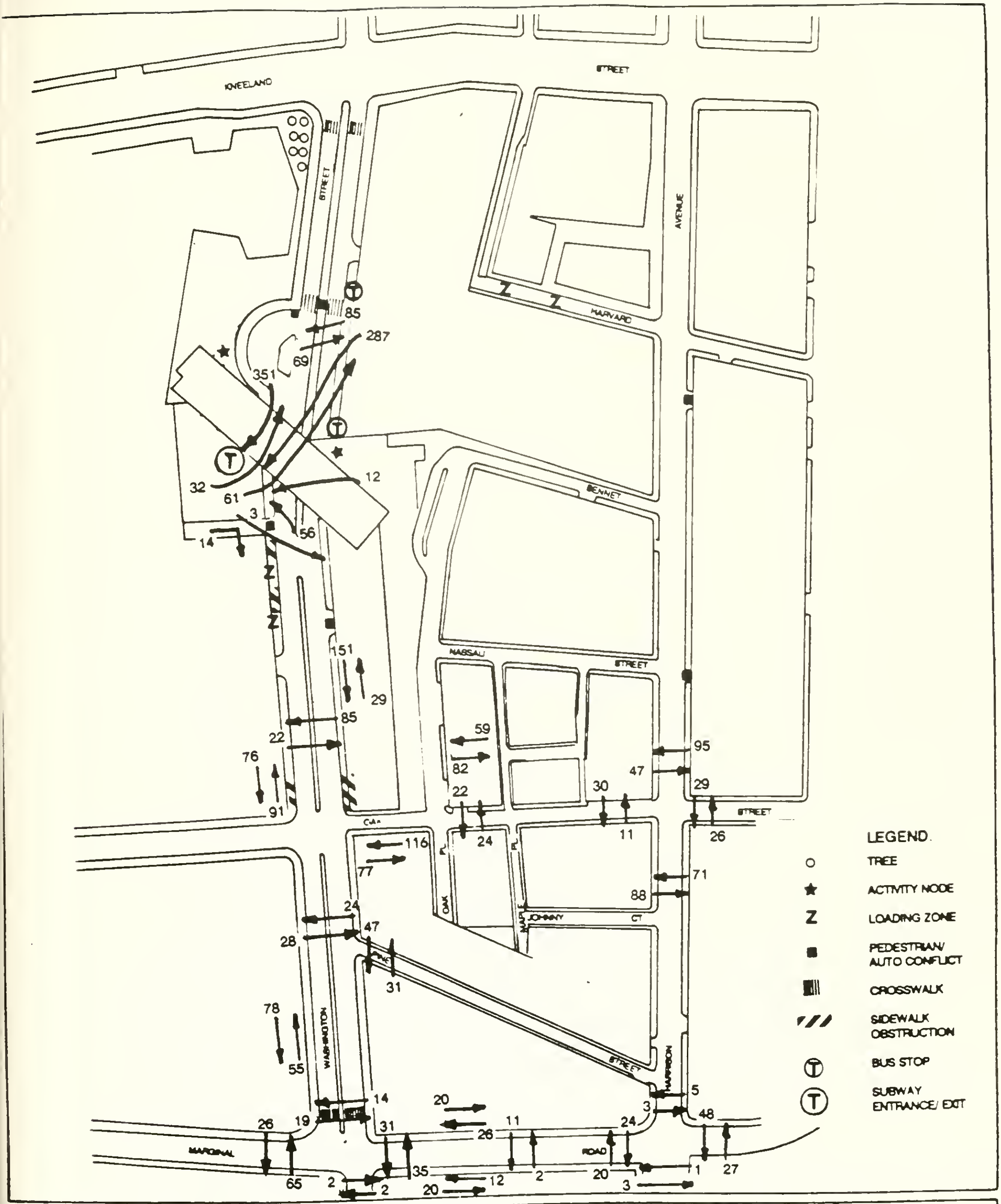
PEDESTRIAN VOLUMES:PEAK HOUR 8-9 AM

NEW ENGLAND MEDICAL CENTER AREA

Figure 2.10



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PEDESTRIAN VOLUMES:PEAK HOUR 4-5 PM

NEW ENGLAND MEDICAL CENTER AREA

Figure 2.11

Washington Street from Kneeland Street to Marginal Road

On this section of the Washington Street corridor, pedestrian volumes are moderate while traffic volumes are heavy. There is presently no construction activity in this area. Sidewalks are generally in good condition and of adequate width to accommodate the existing volume of pedestrians.

Most pedestrian activity is concentrated at the entrances to NEMC and Tufts Medical buildings. Specifically, the entrance to the Floating Hospital and auto pick-up/drop-off area on the east side and the midblock hospital entrance on the west side are activity centers for pedestrians. Pedestrians cross the street at this location at a crosswalk that cuts through the median strip. There is a pedestrian signal at this location, although all pedestrians do not wait for the light. This path is parallel to the hospital's overhead walkway.

Transit stops and stations are also activity nodes for pedestrians. The New England Medical Center/South Cove subway stop on the Orange Line is located on the west side of the street between the Tremont Street Garage exit and the Floating Hospital entrance. In the morning peak period (7:00 - 9:00 AM), 1,831 people entered or exited the station. In evening peak period (4:00 - 6:00 PM), 528 people entered or exited the station. The large majority of these people who cross Washington Street cross at the crosswalk underneath the hospital's walkway. Bus stops on the east side of the street are congregating points for pedestrians. Bus stops are located in front of 710 Washington street and midblock under the hospital walkway. MBTA bus #11 (City Point to Downtown via Bayview Route) and #49 (Dudley Square to Downtown) stop at these locations.

The only sidewalk obstruction of note is the elevated sidewalk in front of the old Don Bosco building on the northeast corner of Washington and Oak Streets. At this location, a pedestrian must either walk up the elevated portion, walk on a narrow strip of sidewalk between the elevated sidewalk and parked cars, or go out into the street.

Pedestrian crossings are marked by crosswalks and breaks in the median strip in the area of the overhead walkway, in the area of 710 Washington Street and at the corner of Washington and Kneeland. The raised nature of the median strip does not allow pedestrians to stand on it or cross over it. However, a pedestrian/auto conflict exists at the entrance to the drop-off/pick-up area outside the Floating Hospital. There is a break in the median for cars at this point. Pedestrians also cross the street at this break, competing for the same space with cars.

A midblock pedestrian/auto conflict exists north of Oak Street near Commons Street. From 7AM-9AM, 202 people cross Washington Street at this point, while 212 people cross at this point from 4PM-6PM. In addition to these numbers of midblock crossing pedestrians, traffic volumes would most likely be at their highest during these peak commuting hours, making the conflict more severe.

Harrison Avenue from Kneeland Street to Marginal Road

Pedestrian volumes are light, as are traffic volumes on this corridor. For this reason, there are no pedestrian/pedestrian or pedestrian/auto conflicts that are apparent. Also, there is no construction activity affecting the street or sidewalks. No significant sidewalk obstructions exist at the present time.

The Posner parking lot, located at 172 Harrison Avenue, is an activity node for pedestrians walking to and from their parked cars. Other pedestrian activity is scattered among the various building entrances on the street.

Herald Street Garage

Pedestrians walking from the Herald Street garage have to cross over the Washington Street or Tremont Street bridges (over the Massachusetts Turnpike). However, most people who park there do not walk, but take the frequent shuttle bus to NEMC. Currently, two vans run in a loop to and from the garage and Floating Hospital on Washington Street from 6AM to 9AM and from 3PM to 1AM. The round trip takes about 10 minutes; the vans thus arrive about every five minutes. The route is shown in Figure 2.6, above.

Don Bosco High School

The 608 Don Bosco High School students take school buses which are parked along Oak Street, as well as using the MBTA Orange Line and bus routes which stop at the corner of Oak and Washington. They also cross Washington Street to access stores and restaurants during midday and after school periods.

Quincy School

Of concern with respect to the location of driveways for the Parcel A and B housing development are pedestrian patterns related to the Quincy School on Washington Street and to the many activities of the Quincy School Community Council. To determine school pedestrian activity and issues, an interview was conducted with Donna Cataldo of the school in March, 1990. The following information is based on this interview and subsequent conversations with others in the community.

The school has entrances at Oak and Washington Streets, used by about 15% of students, Shawmut Avenue and Marginal Street, used by 70% of students, and Marginal and Washington Streets (a handicapped accessible entrance) used by 15% of students. Approximately 700 students arrive each day between 8:15 AM and 8:30 AM, during the morn-

ing peak traffic hour (7:45 to 8:45 AM). About two-thirds of the students arrive by buses, mini-buses and vans, some are picked up and dropped off by parents in cars, and the remainder walk.

The remaining school activity occurs outside the traffic peak periods. Approximately 75-100 half-time kindergarten students leave the building at 11:30 AM and the same number of afternoon kindergartners arrive at 12:15 PM. Approximately 700 students leave the building at 2:15 PM.

The vans, mini-buses and buses use the Washington Street side of the building to pick up and discharge passengers. Large buses use the other sides of the building to load or unload. At dismissal, buses are parked along three sides of the building.

After 2:30 PM the only entrance open is at Oak and Washington Streets. During afternoons, the building is used by an afterschool program attended by 132 students, with 107 coming directly from classes in the building, and 25 walking to the school from bus stops, In addition, the building is used until 9:00 PM for community school, adult education, and recreation programs. The Quincy School Community Council is the largest social service provider in Chinatown, and pedestrian traffic at the intersection of Oak and Washington, is the busiest outside of the core business section of Chinatown. The South Cove Community Health Center serves 300-400 patients per day and employs 90 staff. The Quincy School Community Council's many human services programs for children and adults and the Golden Age Center's elderly programs such as the hot lunch program generate up to 400 people per day. The Quincy Towers' elderly residents travelling to and from Chinatown shops on Beach Street also contribute pedestrian traffic.

3.0 FUTURE TRIP GENERATION

3.1 Target Year and Relationship to Other Development

This transportation study has been designed to meet several requirements:

- As a primary objective, it must describe the traffic and transportation impacts associated with NEMC Phase 1-C development to satisfy the MEPA requirements for an Environmental Impact Report.

- It must also provide an overview of traffic impacts associated with the New England Medical Center Master Plan, to satisfy the requirements of the Boston Redevelopment Authority.

- Finally, by agreement with BRA and the community, it must specifically look at traffic and circulation impacts of the Parcel A, B and C development projects.

To best meet these various requirements, the design year for analysis purposes was designated the Year 2000, which represents the ten year time frame which is reflected in the Master Plan. The No Build scenario thus includes background traffic projections for this ten year period. For NEMC development, the analysis is based on full build-out of Phase 1 development, which is the only phase which is expected to be implemented by the design year. This is desirable to meet the MEPA requirements for the Phase 1-C DEIR. In addition, Parcels A, B and C are expected to be implemented within this ten year horizon. However, to give the desired indication of how Phase 1 relates to the impacts of development associated with buildout of the entire Master Plan, however, we have also estimated traffic volumes for Phases 2 and 3 and the Research Building in spreadsheet tables which are included in the Technical Appendix to this report. However, since these developments will likely occur beyond the time frame of the Phase 1-C EIR, and since they represent replacements for existing buildings, we have not specifically included these volumes in the target year traffic analyses. Because they are replacement facilities, the traffic to be generated by the new buildings is essentially accounted for in the existing traffic volumes actually counted on the roadway network.

3.2 Future Year Analysis Assumptions/Methodology

To compare the transportation impacts of the No Build option, the NEMC Phase 1-C developments and the housing developments, the standard steps of the transportation planning process -- trip generation, mode split, trip distribution and network assignment -- were applied to the development parameters for each option, as discussed below.

Trip Generation Rates

Basic to a determination of development project transportation impacts is the estimation of the trips which the project will generate in various time periods of interest and for various travel modes. In this case, trip generation is examined for the AM and PM peak period, and for average weekday travel (AWDT).

As the basis for trip generation in this report, the Institute of Transportation Engineers (ITE) Trip Generation Manual, 1987 edition, was used. It is one of the major references used in the estimation of trip generation which presents trip generation rates for a wide variety of land uses based on surveys of actual developments located at various sites across the country.

The rates in the Manual deal with vehicle trips only, and in dominantly suburban settings where transit service is negligible. There is also no overt consideration of car occupancy as a variable factor, nor any division between journey to/from work and other trips. In order to apply these rates to central Boston where transit and walk-in trips play substantial access roles, the Manual vehicle trip rates had to be converted to person trip rates. The person trips had to be then broken down into the various travel modes (automobile, transit, walking) and work/non-work categories. Vehicle trips were obtained by dividing auto person trips by appropriate car occupancy factors.

In this report, person trips were obtained from the ITE vehicle rates by conversion factors related to ITE probable car occupancies and an allowance for some nominal transit and walk access.[1] The resultant person trip rates for each activity and time period were also compared for compatibility with person trip rates used in other Boston transportation analyses. Trip estimation had to be done for each land use component for each development option considered.

The Boston trip generation sources referred to were Central Transportation Planning Staff (CTPS) interim trip generation rates related to the Central Artery project, the 1989 Access Plan Guidelines of the Boston Transportation Department (BTD), and a number of EIR's for previous Downtown Boston developments. These were referenced for consistency checks and used for the estimation of the division between work and non-work trips. The person trip rates adopted are presented in Table 3.1 for each land use by

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1. ITE car occupancies differ by land use and trip purpose (i.e. work/nonwork). For example, for office work trips, ITE car occupancy reflected in the vehicle trip rates in the Trip Generation manual is assumed to be 1.2, with very little transit use. To convert these vehicle rates into person trips, the initial number of trips is multiplied by 1.2, then by an additional 10% to account for possible transit or walk trips not reflected in the ITE rates. The result is a conservative 1.32 multiplier applied to the vehicle trip rates. This would be applied as follows: To convert 100 vehicle trips to person trips, multiply the trips by 1.32. The resulting person trips would be 132.

Table 3.1 - Person Trip Generation Rates

	HOSPITAL (1,000 sf)		RESEARCH (1,000 sf)		HOUSING (unit)		RECREATION (1,000 sf)		HOTEL (room)		RETAIL (1,000 sf)		DAY CARE (1,000 sf)	
Adj. Factors:														
Transit -		na		6.0%		9.0%		na		0.0%		na		na
V. Occ. -		na		1.2		1.8		na		1.6		na		na
Source:	BTD/CTPS		ITE #760		ITE #222		BTD/CTPS		ITE #320		BTD/CTPS		BTD/CTPS	
	Unadj. Rate	Person Trip Rate	Unadj. Rate	Person Trip Rate	Unadj. Rate	Person Trip Rate	Unadj. Rate	Person Trip Rate	Unadj. Rate	Person Trip Rate	Unadj. Rate	Person Trip Rate	Unadj. Rate	Person Trip Rate
ADT -														
work	6.80	6.80	4.58	5.85	2.16	4.27	0.84	0.84	1.29	2.06	4.50	4.50	3.56	3.56
non-work	9.20	9.20	2.46	3.14	3.24	6.41	83.36	83.36	7.32	11.71	32.90	32.90	114.84	114.84
total	16.00	16.00	7.04	8.99	5.40	10.68	84.20	84.20	8.61	13.78	37.40	37.40	118.40	118.40
AM PEAK HOUR -														
IN: work	0.80	0.80	0.82	1.05	0.05	0.10	0.11	0.11	0.05	0.08	0.18	0.18	0.39	0.39
non-work	0.30	0.30	0.20	0.26	0.07	0.14	3.41	3.41	0.39	0.62	0.12	0.12	12.32	12.32
total	1.10	1.10	1.02	1.30	0.12	0.24	3.52	3.52	0.44	0.70	0.30	0.30	12.71	12.71
OUT: work	0.20	0.20	0.00	0.00	0.14	0.28	0.00	0.00	0.02	0.03	0.00	0.00	0.00	0.00
non-work	0.10	0.10	0.11	0.14	0.20	0.40	0.88	0.88	0.20	0.32	0.20	0.20	9.59	9.59
total	0.30	0.30	0.11	0.14	0.34	0.67	0.88	0.88	0.22	0.35	0.20	0.20	9.59	9.59
TOTAL: work	1.00	1.00	0.82	1.05	0.19	0.38	0.11	0.11	0.07	0.11	0.18	0.18	0.39	0.39
non-work	0.40	0.40	0.31	0.40	0.27	0.53	4.29	4.29	0.59	0.94	0.32	0.32	21.91	21.91
total	1.40	1.40	1.13	1.44	0.46	0.91	4.40	4.40	0.66	1.06	0.50	0.50	22.30	22.30
PM PEAK HOUR -														
IN: work	0.10	0.10	0.06	0.08	0.11	0.22	0.00	0.00	0.00	0.00	0.22	0.22	0.00	0.00
non-work	0.20	0.20	0.11	0.14	0.16	0.32	2.08	2.08	0.35	0.56	0.87	0.87	10.37	10.37
total	0.30	0.30	0.17	0.22	0.27	0.53	2.08	2.08	0.35	0.56	1.09	1.09	10.37	10.37
OUT: work	0.80	0.80	0.82	1.05	0.07	0.14	0.09	0.09	0.02	0.03	0.44	0.44	0.34	0.34
non-work	0.50	0.50	0.14	0.18	0.11	0.22	3.03	3.03	0.28	0.45	1.77	1.77	10.89	10.89
total	1.30	1.30	0.96	1.23	0.18	0.36	3.12	3.12	0.30	0.48	2.21	2.21	11.23	11.23
TOTAL: work	0.90	0.90	0.88	1.12	0.18	0.36	0.09	0.09	0.02	0.03	0.66	0.66	0.34	0.34
non-work	0.70	0.70	0.25	0.32	0.27	0.53	5.11	5.11	0.63	1.01	2.64	2.64	21.26	21.26
total	1.60	1.60	1.13	1.44	0.45	0.89	5.20	5.20	0.65	1.04	3.30	3.30	21.60	21.60

analysis period, divided into work and non-work categories. (It may be noted that a "work" trip includes only the journeys to or from the place of employment. "Additional" trips made by employees, even on business, would be considered "non-work.")

Modal Split and Car Occupancy Calculations

As stated above, the determination of total person trip generation is followed by the assignment of the person trips for each land use to the appropriate mode of transportation; i.e., automobile, transit, or walk/other (taxi, bike, etc.). For the vehicle trips, auto person trips are converted to auto trips by vehicle occupancy factors, i.e., the number of persons per car for each type of trip.

Mode split and vehicle occupancy tend to vary between different land uses due to the specific trip making characteristics related to each. The distinction between various mode split and vehicle occupancy factors also applies to the type of trip being made, most commonly divided into work and non-work trips. For example, the mode split for hotel workers is similar to that for office workers or retail workers, but hotel guests will have very different patterns both from the hotel workers and from office visitors or retail customers. Mode split and vehicle occupancy is also heavily influenced by the location of the particular development, especially in terms of vehicular and transit accessibility and parking availability and price.

Table 3.2 presents the mode split and vehicle occupancy trip making characteristics by land use for work and non-work trips to the NEMC and Chinatown development sites as fairly typical Downtown Boston locations. These mode split and vehicle occupancy factors are derived from the NEMC employee surveys conducted by Howard/Stein-Hudson Associates, as described in Section 2.3 above and from environmental impact reports from recent nearby projects, as shown in the Table.

Trip Distribution

The basis for the trip distribution proportions was the origin/destination information gathered for workers from the NEMC employee survey, for visitors from the 1986 Vanasse Hangen visitor survey, and for residents, CTPS 1980 Journey to Work data, all as described above and set forth in Tables 2.3 to 2.7 for the different travel modes, and summarized below.

Table 3.2
NEMC/Chinatown Trip Characteristics

Mode Split:

Land Use	Auto	Vehicle Occupancy	Transit	Walk/ Other	Source:
Hospital:					
work	53.2%	1.1	43.8%	3.0%	H/SH Survey (1990)
non-work	60.0%	1.5	29.4%	10.6%	V/H Survey (1986)
Research:					
work	53.2%	1.1	43.8%	3.0%	H/SH Survey (1990)
non-work	27.5%	1.4	57.5%	15.0%	One Lincoln & Comm. Ctr. EIRs
Housing:					
work	33.0%	2.1	10.0%	57.0%	CTPS
non-work	28.0%	1.1	35.0%	37.0%	Parkside West Access Plan (adj.)
Recreation:					
work	30.0%	1.4	65.0%	5.0%	Comm. Ctr. EIRs
non-work	27.5%	1.4	32.5%	40.0%	Comm. Ctr. EIRs
Hotel:					
work	30.0%	1.4	60.0%	10.0%	One Lincoln EIRs
non-work	55.0%	1.9	20.0%	25.0%	One Lincoln EIRs
Retail:					
work	30.0%	1.4	60.0%	10.0%	One Lincoln & Comm. Ctr. EIR's
non-work	27.5%	1.9	32.5%	40.0%	One Lincoln & Comm. Ctr. EIR's
Day Care:					
work	30.0%	1.4	65.0%	5.0%	Comm. Ctr. EIRs
non-work	27.5%	2.3	32.5%	40.0%	Comm. Ctr. EIRs (adjusted)

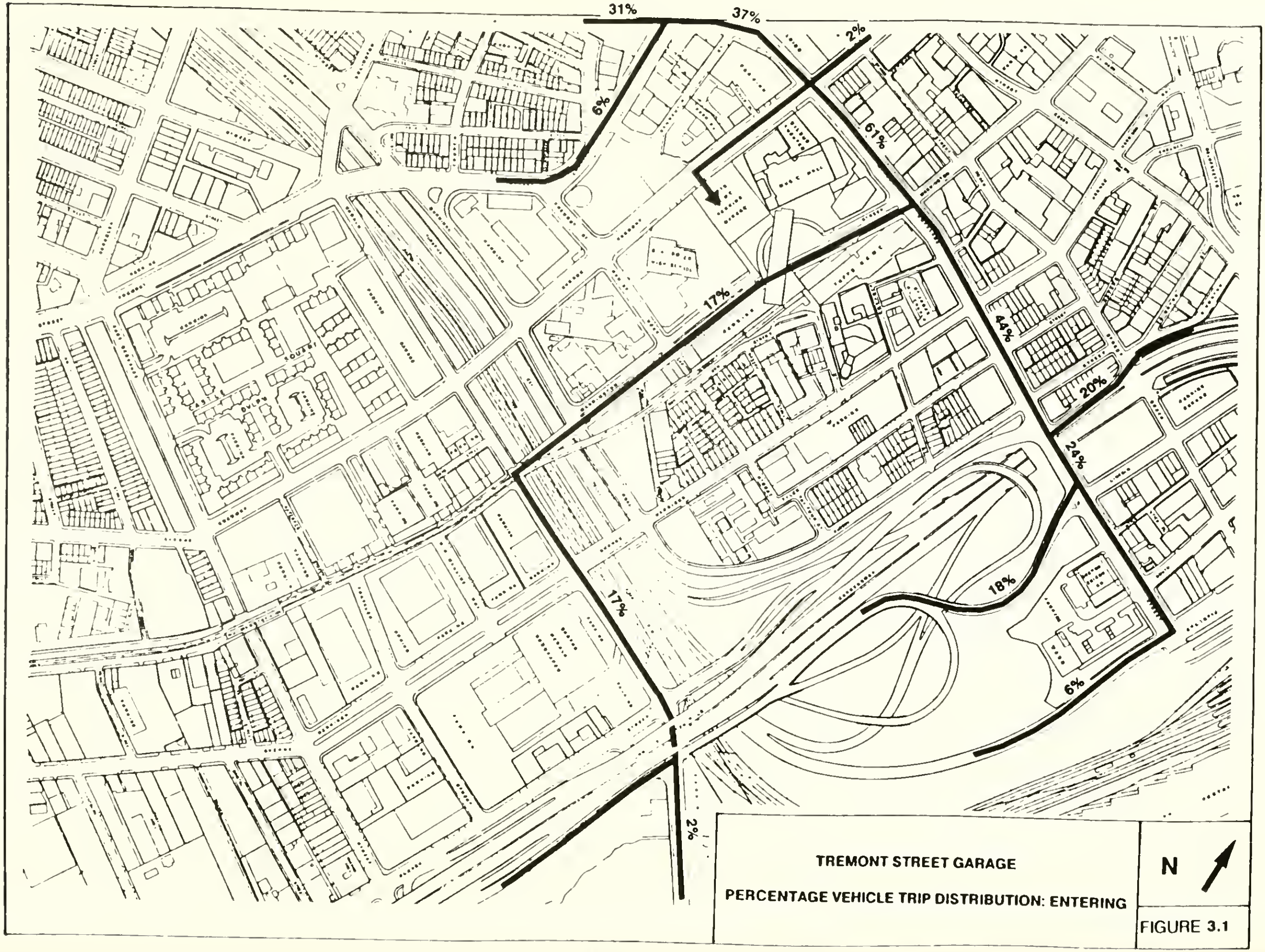
Vehicle Trips: The future project traffic volumes for impact analyses of NEMC development and the proposed housing developments at key study area intersections were estimated by distributing the vehicle trips generated into the directions of origin/destination, and assigning this directional division of trips to the actual roadways serving the development. Trip distribution was calculated separately for each development, since access to and from the parking lots and garages differed given the one-way street patterns in the area. Similarly, distribution of trips was different for entering vs. exiting traffic. Existing street features were assumed in the trip distribution analysis. For example, no left turns were assumed into the Parcel A/B garage from Washington Street southbound, due to the presence of the median in Washington Street at the project driveway. Figures 3.1 through 3.6 summarize the vehicular trip distribution for the existing NEMC garages, (the Herald Street Garage and the Tremont Street Garage), and the proposed Chinatown housing developments. Once the traffic was assigned to the street system in accordance with these guidelines, the resulting volumes, when added to background growth traffic formed the future year traffic volume input for calculation of Levels-of-Service (LOS).

Public Transportation Trips: Public transportation trips were distributed to the various transit modes serving the site on the basis of station use reported in the NEMC survey, as shown in Table 2.4, above. The new NEMC Orange Line station accounts for 68% of all transit user activity, followed by Boylston Station with 13% then Downtown Crossing with 9%. About 5% of the transit riders walk from South Station.

Pedestrian Trips: Pedestrian trip distribution was based on an analysis of relative boardings at the transit stations within walking distance of the site, and likely midday pedestrian trips to and from the Downtown Crossing shopping district and Chinatown. It is anticipated that the primary entrance and exit for the 1-C North Building will be provided on Washington Street, and the entrance/exit for the Phase 1-C South Building on Ash Street, as shown in Figure 3-7. For each of these locations, primary pedestrian flows will occur on Washington Street between Nassau Street, the MBTA Station entrance, and Kneeland Street. Secondary flows will occur across Washington Street to the Tremont Street parking garage, along Nassau Street towards Harrison Avenue parking locations, and along Washington Street southbound.

3.3 No-Build Trip Estimation

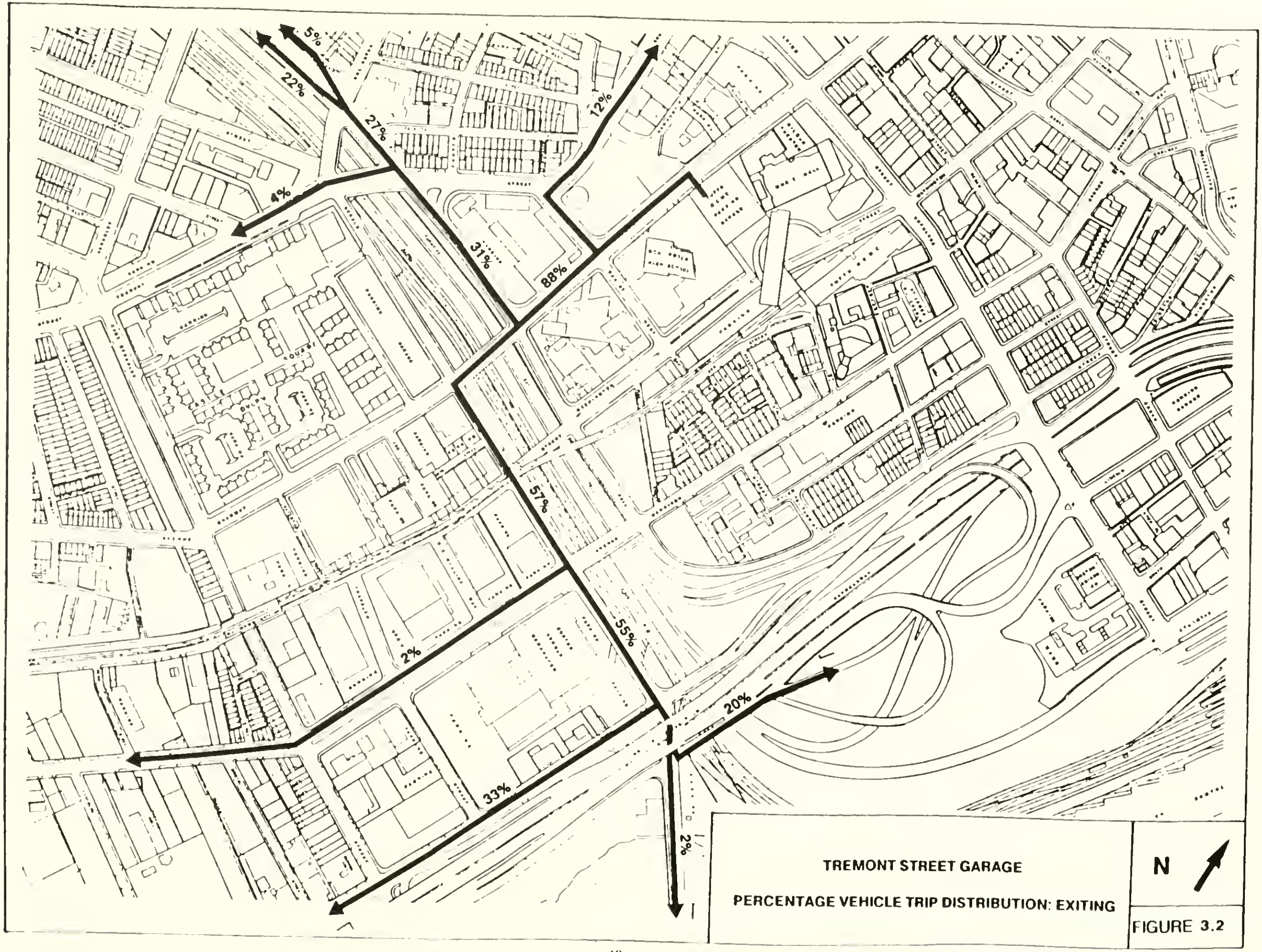
As agreed in the Scope of Work for this project, the estimates of future traffic in the target year 2000 without the projects ("No-Build") being dealt with in this report were based upon the build traffic levels for the Boston Crossing project as found in its Environmental Impact Report. Since the Boston Crossing target year is 1995, it was necessary to use a method that would project No-Build traffic growth to the NEMC year of 2000.



TREMONT STREET GARAGE

PERCENTAGE VEHICLE TRIP DISTRIBUTION: ENTERING

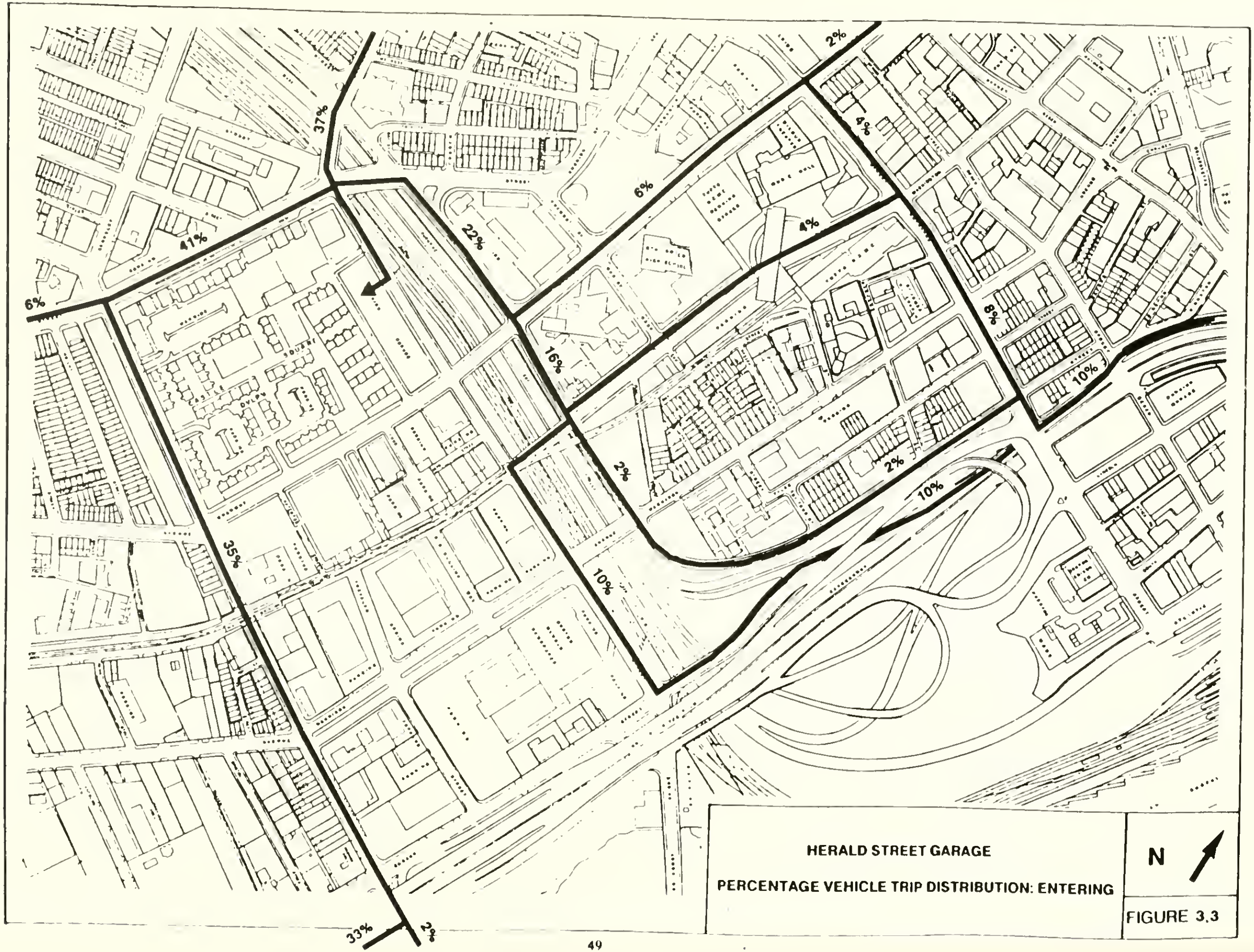
FIGURE 3.1



TREMONT STREET GARAGE

PERCENTAGE VEHICLE TRIP DISTRIBUTION: EXITING

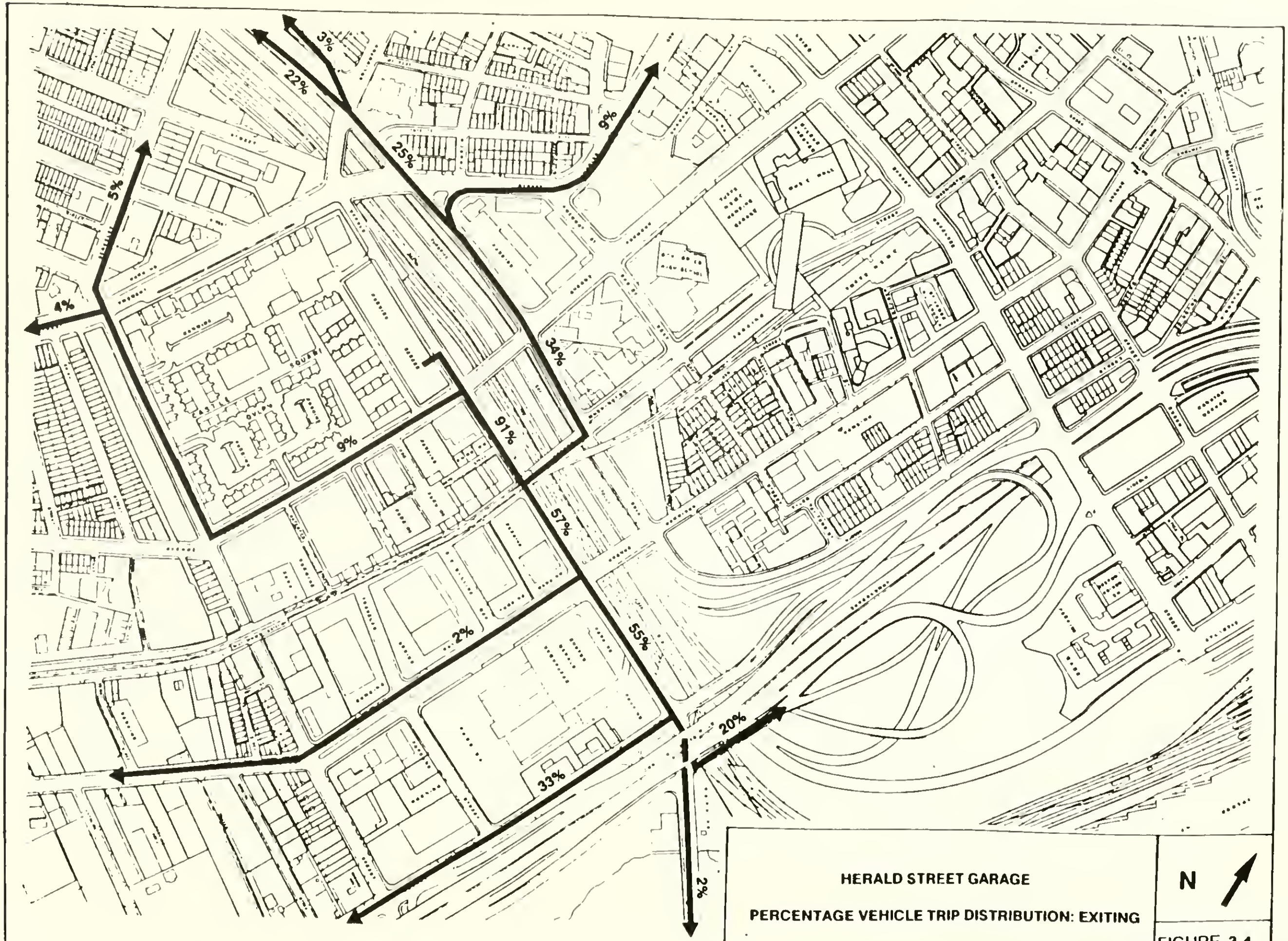
FIGURE 3.2



HERALD STREET GARAGE

PERCENTAGE VEHICLE TRIP DISTRIBUTION: ENTERING

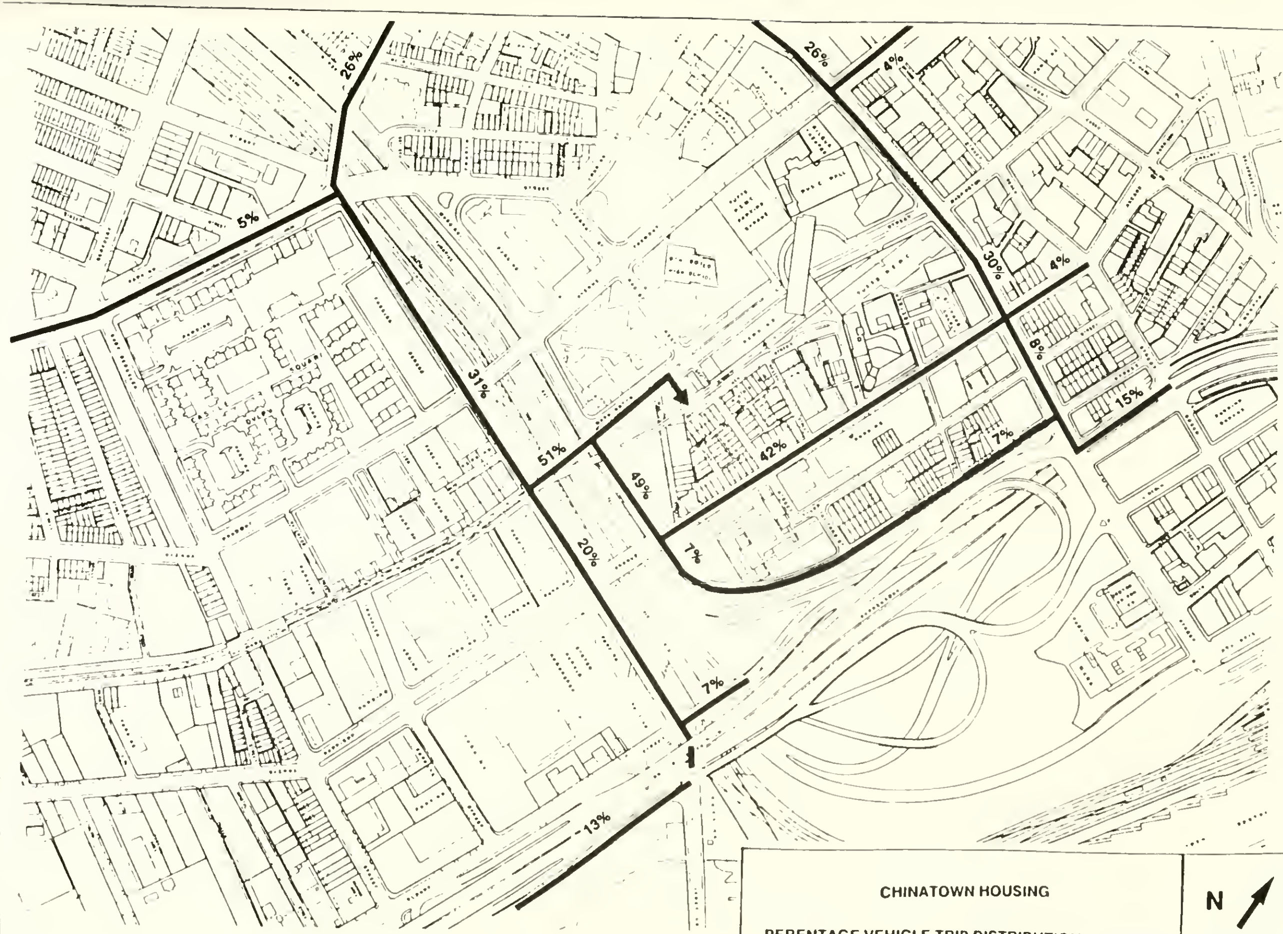
FIGURE 3.3



HERALD STREET GARAGE

PERCENTAGE VEHICLE TRIP DISTRIBUTION: EXITING

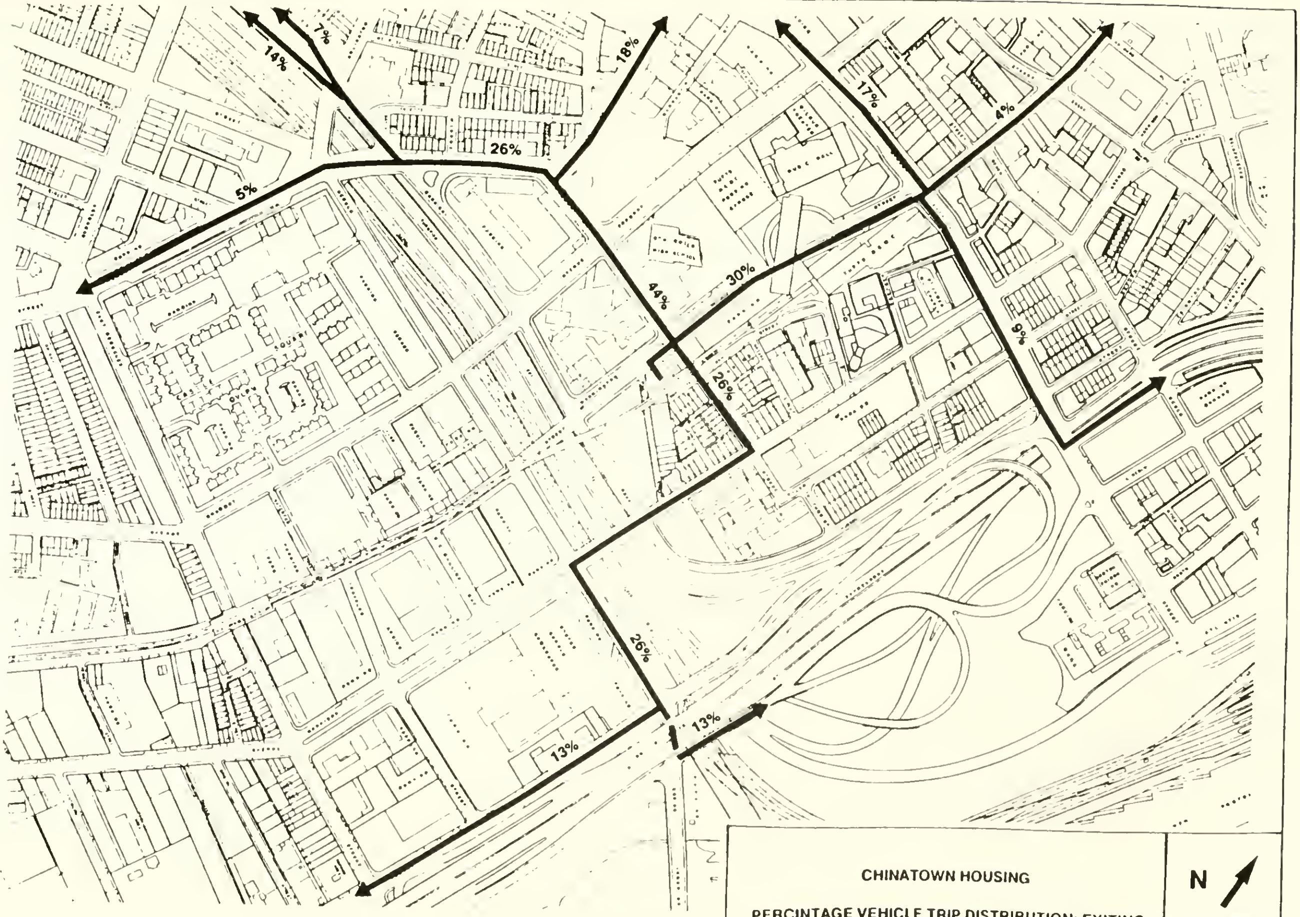
FIGURE 3.4



CHINATOWN HOUSING

PERENTAGE VEHICLE TRIP DISTRIBUTION: ENTERING

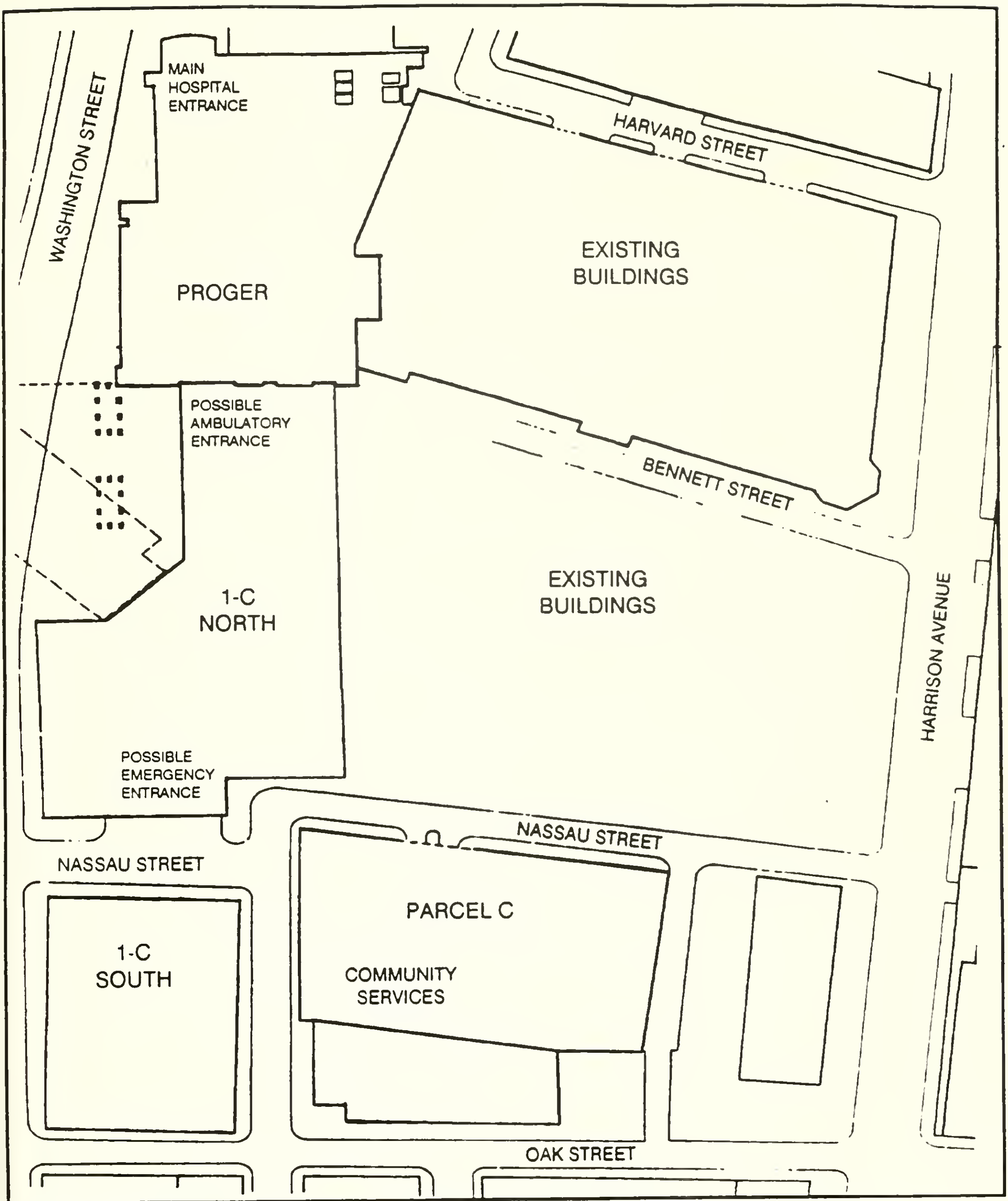
FIGURE 3.5



CHINATOWN HOUSING

PERCINTAGE VEHICLE TRIP DISTRIBUTION: EXITING

FIGURE 3.6



HOWARD/STEIN-HUDSON ASSOCIATES

NEMC 1-C BUILDINGS
GROUND LEVEL PEDESTRIAN ACCESS
(Preliminary)

Source: Elkus-Manfredi

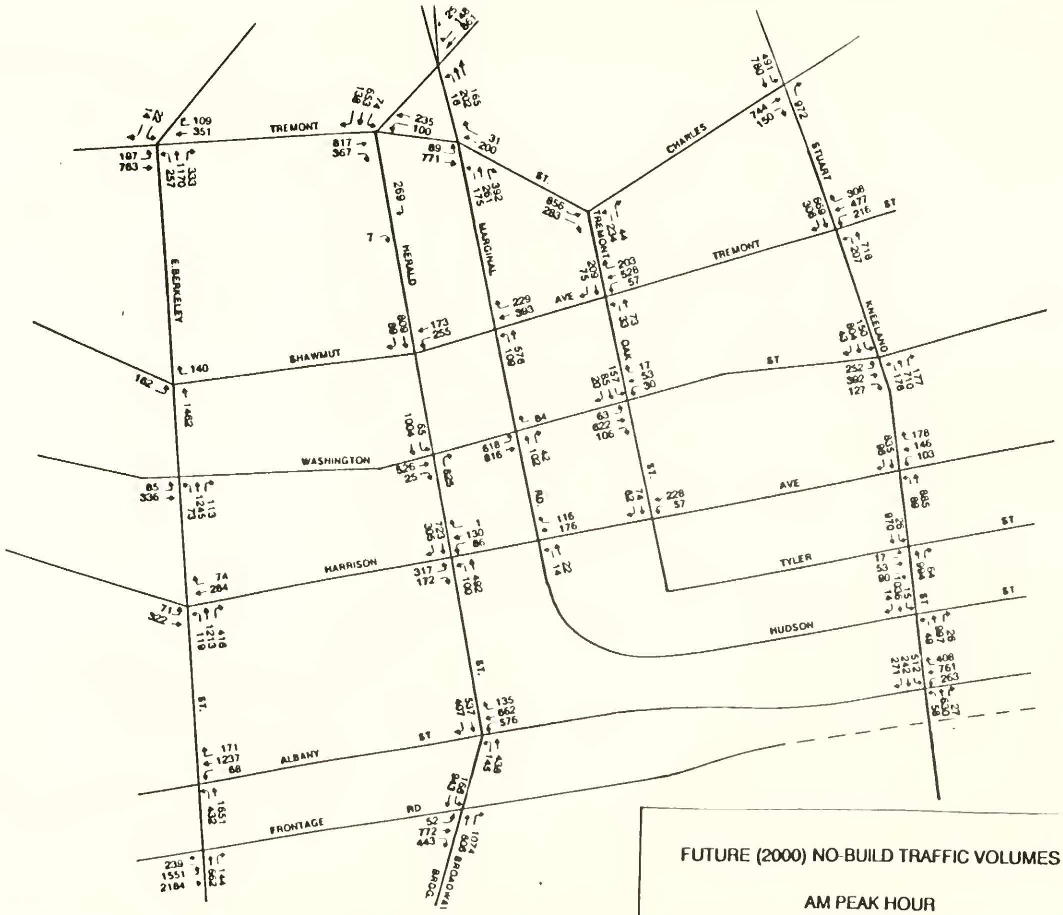
N ↑

Figure 3.7

A growth factor approach was selected based on the Boston Crossing traffic changes on Harrison Avenue and Washington Street as the streets lead directly into the Study Area at the common boundary of Kneeland Street. The existing counts at these locations are the same for Boston Crossing and this project, giving base volume consistency. The growth in this traffic for the Boston Crossing target year averaged 13% for the AM and PM peak hour, and this value was applied to both periods.

The future target year for Boston Crossing, 1995, is different than the target year of 2000 for this report. For this reason, an annual growth rate was calculated and applied to the longer period. One important adjustment was made, involving the Boston Crossing future year. Due to the fact that a number of projects covered in the Boston Crossing work have experienced longer approval and development financing processes than expected, and that there is also a general slowing of downtown development at the present time, the 1995 target year was changed by two years to 1997 for rate calculations. With this assumption, the annual (compound) growth rate amounts to 1.54%, yielding a total increase of 18% for the 1989 to 2000
period.

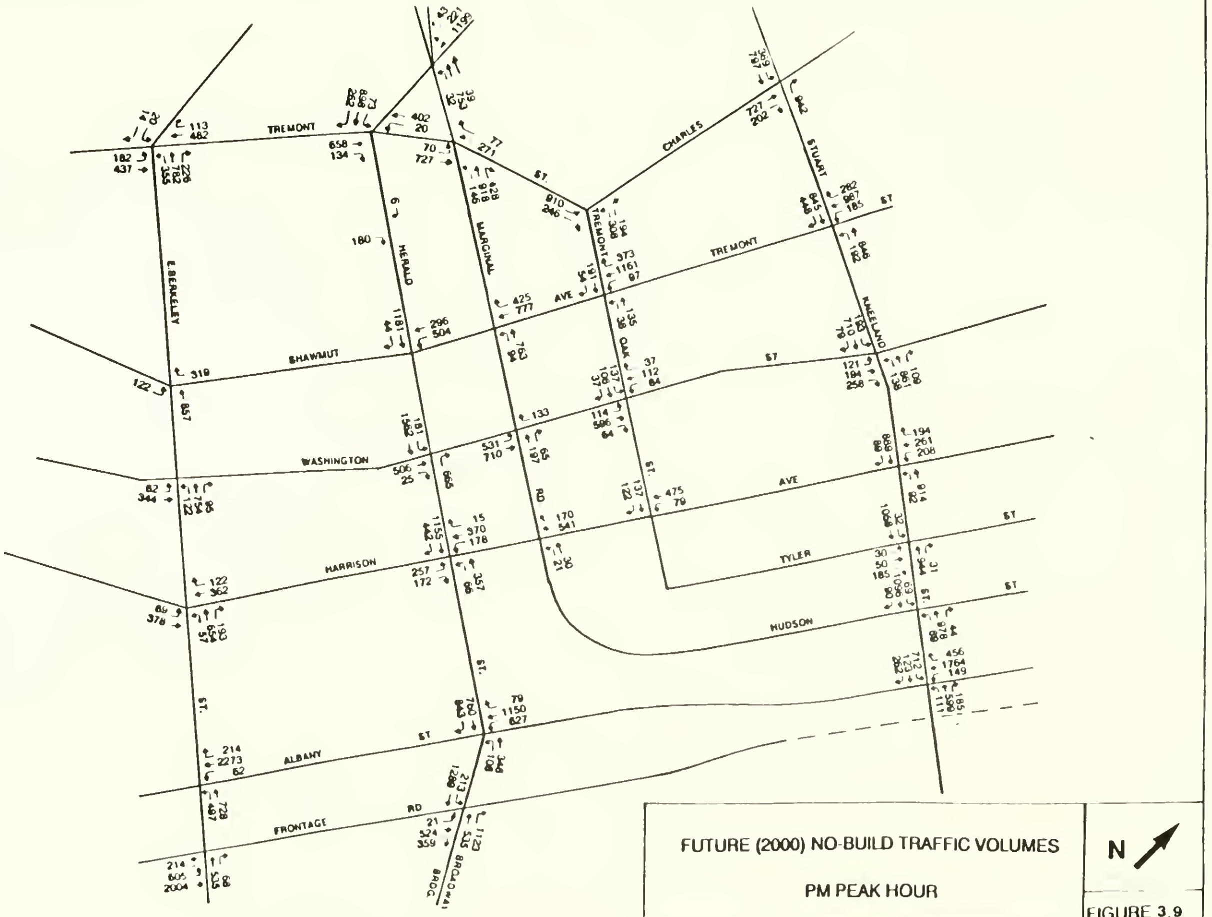
To complete the No-Build analysis, two additional No-Build increments were accounted for, namely the further development of the Tufts University Medical School and the Centennial Partners proposed mixed use development on Tremont Street. The Centennial Partners project was accounted for by distributing and adding the estimated vehicle trip generation to the access streets involved. The Tremont Street Garage trip distribution (as shown in Figures 3.3 and 3.4) was used as the basis for this assignment. Tufts development was accounted for by growth factor method. It was estimated that Tufts could add about an additional 250,000 SF by the year 2000 (subsequently stated as about 283,000 SF, but not different enough to warrant modification in the analyses). This 250,000 SF was compared to the inventory of floor space in the core study area (CTPS Zones 30A, 30B & 30C), and amounted to about 5%. Existing trips were factored upward by this additional 5%. No-build levels were therefore estimated at about 23% (18% + 5%) higher than existing plus the specific addition of the Centennial project. Year 2000 estimated No-build volumes for the AM and PM peak hours are shown in Figures 3.8 and 3.9.



FUTURE (2000) NO-BUILD TRAFFIC VOLUMES

AM PEAK HOUR

FIGURE 3.8



FUTURE (2000) NO-BUILD TRAFFIC VOLUMES

PM PEAK HOUR

FIGURE 3.9

3.4 Trip Generation of Projects

Utilizing the person trip generation rates, modal split, and car occupancies described above, the trip generation of the projects under study was estimated for an average weekday and the AM and PM peak hours by applying the rates and factors to the development programs involved. The resultant total person trips are shown in Table 3.3, with vehicle, transit, and walk trips being shown in Tables 3.4 to 3.6, respectively.

These trip generation results can be viewed in several different ways. To give a comparison of the relative importance of the three modes of travel analyzed, total two-way person trips are summarized by mode by analysis period in bar charts of Figure 3.10. Here the significant roles being played by transit and walking can be seen. Expressed as mode use percentages the person tripmaking is further summarized in the following table:

	Percentage of Trips by Indicated Mode		
Person Trip Mode	**ADT**	**AM Peak Hour**	**PM Peak Hour**
Automobile	34.8%	37.8%	37.7%
Public Transit	32.6%	34.0%	33.7%
Walk Only	32.6%	28.1%	28.5%
Person Trips All Modes	13,836 100%	1,002 100%	1,097 100%

As shown above, person trips by automobile account for only about one-third of all daily tripmaking to and from the study area for the various projects, and slightly more than one-third in the peak hours. Transit and walking account about equally for the remaining two-thirds of all person trips.

Table 3.3
Total Person Trip Generation

			AM PEAK HOUR			PM PEAK HOUR		
Phase/Use	Size (000 sf)	ADT	In	Out	Total	In	Out	Total
NEMC:								
Phase 1C-North -								
Hospital	121.03 sf	1,936	133	36	169	36	157	194
Research	50.00 sf	449	65	15	80	11	65	76
1C-N total	171.03 sf	2,386	198	51	250	47	222	269
Phase 1C-South -								
Hospital	50.94 sf	815	56	15	71	15	66	82
Research	30.00 sf	270	39	9	48	7	39	46
1C-S total	80.94 sf	1,085	95	24	119	22	105	127
Subtotal NEMC 1C	251.97 sf	3,470	293	76	369	69	328	397
Parcel A -								
Housing	141 du	1,506	33	95	128	75	50	126
Parcel B -								
Housing	120 du	1,282	28	81	109	64	43	107
Parcel C -								
Recreation	90.00 sf	7,578	317	79	396	187	281	468
Subtotal Chinatown	90.00 sf 261 du	10,366	379	255	633	327	374	700
Total Study Area	**341.97 sf** **261 du**	**13,836**	**672**	**330**	**1,002**	**396**	**701**	**1,097**

Table 3.4
Vehicle Trip Generation

			AM PEAK HOUR			PM PEAK HOUR		
Phase/Use	Size	ADT	In	Out	Total	In	Out	Total
NEMC								
Phase 1C-North -								
Hospital	121.03 sf	843	61	17	78	16	71	87
Research	50.00 sf	172	28	1	29	3	27	30
1C-N total	171.03 sf	1,016	89	18	107	19	98	117
Phase 1C-South -								
Hospital	50.94 sf	355	26	7	33	7	30	36
Research	30.00 sf	103	17	1	18	2	16	18
1C-S total	80.94 sf	458	43	8	50	8	46	55
Subtotal NEMC 1C	251.97 sf	1,474	132	26	157	27	144	171
Parcel A -								
Housing	141 du	325	7	20	27	16	11	27
Parcel B -								
Housing	120 du	276	6	17	23	14	9	23
Parcel C -								
Recreation	90.00 sf	1,490	62	16	78	37	55	92
Subtotal Chinatown	90.00 sf 261 du	2,091	76	53	129	67	75	142
Total Study Area	**341.97 sf** **261 du**	**3,565**	**207**	**79**	**286**	**94**	**220**	**314**

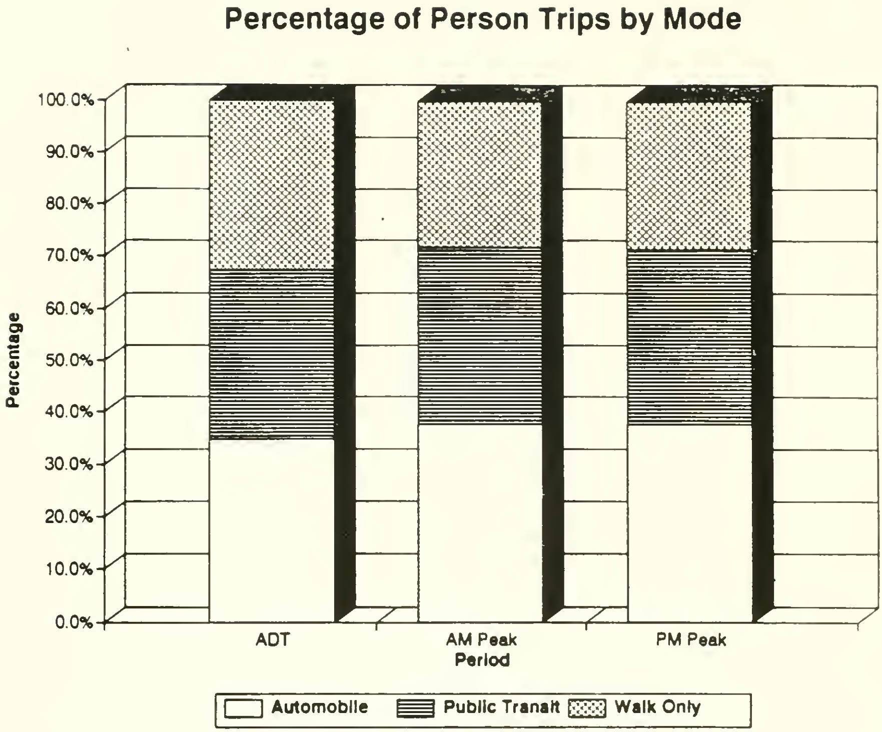
Table 3.5
Transit Person Trip Generation

			AM PEAK HOUR			PM PEAK HOUR		
Phase/Use	Size	ADT	In	Out	Total	In	Out	Total
NEMC								
Phase 1C-North -								
Hospital	121.03 sf	688	53	14	67	12	60	73
Research	50.00 sf	218	30	4	34	6	28	34
1C-N total	171.03 sf	906	83	18	102	18	88	106
Phase 1C-South -								
Hospital	50.94 sf	290	22	6	28	5	25	31
Research	30.00 sf	131	18	2	20	3	17	20
1C-S total	80.94 sf	421	41	8	48	9	42	51
Subtotal NEMC 1C	251.97 sf	1,327	124	26	150	27	130	157
Parcel A -								
Housing	141 du	377	8	23	31	19	13	32
Parcel B -								
Housing	120 du	320	7	20	27	16	11	27
Parcel C -								
Recreation	90.00 sf	2,487	106	26	132	61	94	155
Subtotal Chinatown	90.00 sf 261 du	3,184	121	69	190	95	117	213
Total Study Area	**341.97 sf** **261 du**	**4,511**	**245**	**96**	**341**	**122**	**248**	**370**

Table 3.6
Walk Trip Generation

			AM PEAK HOUR			PM PEAK HOUR		
Phase/Use	Size	ADT	In	Out	Total	In	Out	Total
NEMC								
Phase 1C-North -								
Hospital	121.03 sf	143	7	2	9	3	9	12
Research	50.00 sf	32	3	1	4	1	3	4
1C-N total	171.03 sf	175	10	3	13	4	12	16
Phase 1C-South -								
Hospital	50.94 sf	60	3	1	4	1	4	5
Research	30.00 sf	19	2	1	3	1	2	3
1C-S total	80.94 sf	79	5	2	7	2	6	8
Subtotal NEMC 1C	251.97 sf	255	15	5	20	6	18	24
Parcel A -								
Housing	141 du	678	15	43	58	34	22	56
Parcel B -								
Housing	120 du	577	13	37	50	29	19	48
Parcel C -								
Recreation	90.00 sf	3,005	123	32	155	75	109	184
Subtotal Chinatown	90.00 sf 261 du	4,259	151	111	262	138	151	289
Total Study Area	**341.97 sf** **261 du**	**4,514**	**167**	**116**	**282**	**144**	**169**	**313**

Figure 3.10


Percentage of Person Trips by Mode
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Percentage
ADT
AM Peak
PM Peak
Period
Automobile
Public Transit
Walk Only

Since the impact of automobiles is of prime importance in the impact analyses, the relative contribution of Build condition vehicle trips from the component projects is set forth in the bar charts of Figure 3.11. This allows an overview of the trip generation share of each project in total auto impacts which can be attributed to the projects being analyzed. The percentage contributions are shown as follows:

	Proportion of Vehicle Trips Generated by Component Project:					
	ADT		AM Peak Hour		PM Peak Hour	
Build Project	Trips	%	Trips	%	Trips	%
NEMC Phase 1-C	1,474	41.3	157	55.1	171	54.5
Parcel A - CEDC Housing	325	9.2	27	9.5	27	8.7
Parcel B - ACDC Housing	276	7.7	23	8.1	23	7.4
Parcel C - Recreation Ctr.	1,490	41.8	78	27.4	92	29.4
Total Build Projects	**3,565**		**285**		**313**	

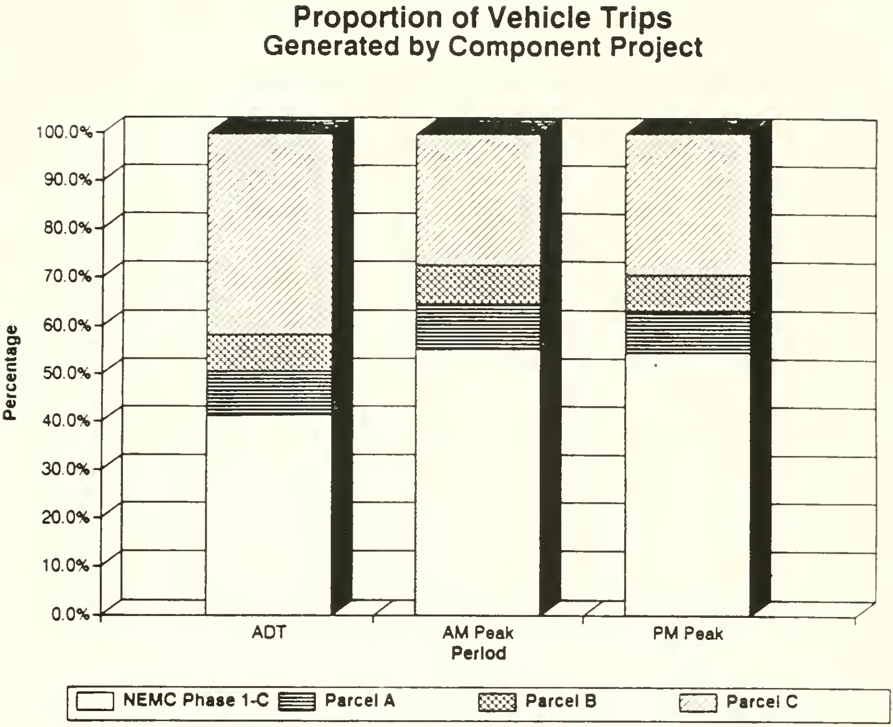
The effect of differences in the concentrations of travel during peak hours among the several projects can be seen. Although the largest peak hour contributor is the NEMC 1-C project, the ADT trip contribution is only 41%. The daily travel of the Recreation Center is most striking at 41.8%. It is of course the peak hour traffic which is of greatest concern in judging transportation impacts.

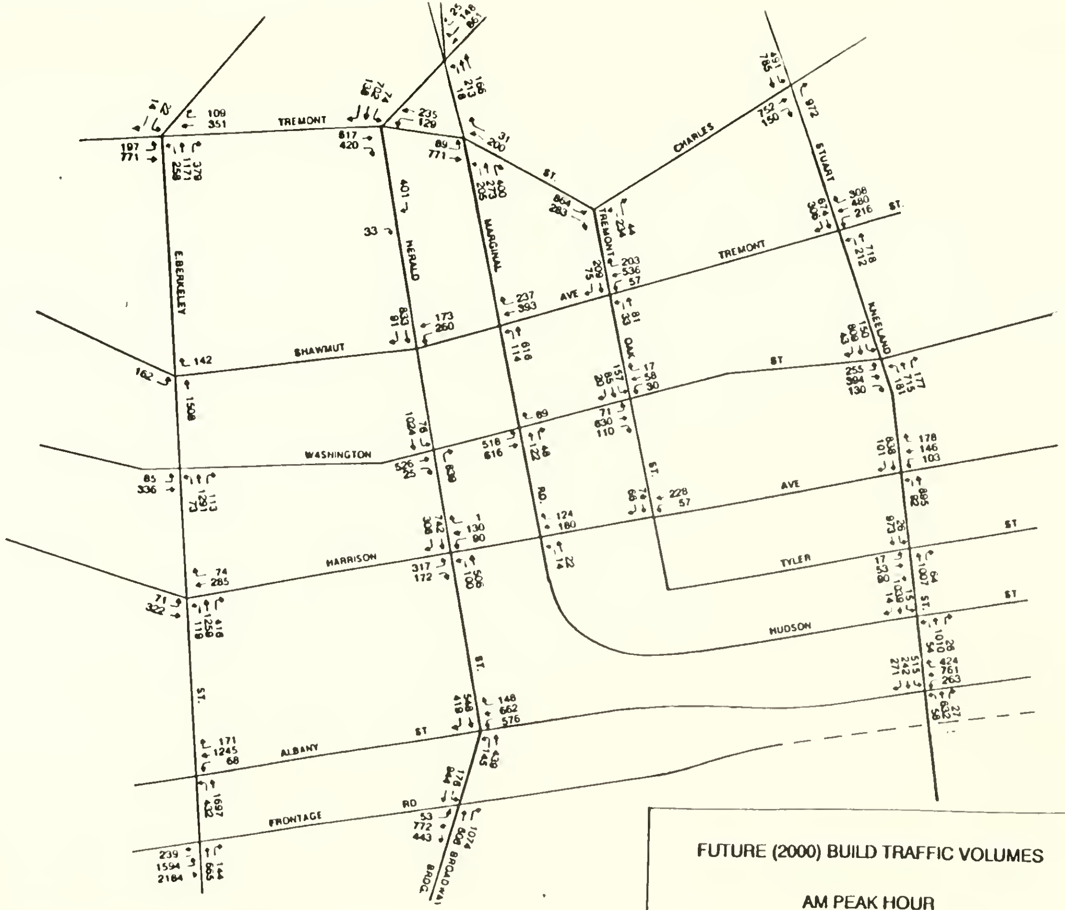
3.5 Assignment of Trips to Streets and Transit

Streets - The vehicle trips generated were assigned to the roadway network according to the patterns of regional trip distribution described under Existing Conditions above. The assignment of Build NEMC trips was centered on the Herald Street Garage, the expansion of which is envisioned as the destination for net increases in NEMC tripmaking. For the housing and the Recreation Center, trips were centered on the assumed parking entrance(s) at each site. As an example of the street routings chosen in the assignment process, Figures 3.1 and 3.2, above, show the patterns for entering and exiting vehicles using the Herald Street Garage. The assigned project trips were added to the No-Build volumes to yield the AM and PM Peak Hour Build volumes shown for the Study Area in Figures 3.12 and 3.13, respectively.

Transit - Transit (person) trip generation was also distributed to the transit system according to the distribution pattern described above, based on the assumption that the regional tripmaking patterns would not change significantly over the analysis period to year 2000. The results of this assignment process for the various transit lines and other carriers is shown in Table 3.7. The largest transit service to study projects is afforded by NEMC Station on the Orange Line, followed by the Green Line (Boylston) and the Red Line (Downtown Crossing or South Station).

Figure 3.11


Proportion of Vehicle Trips
Generated by Component Project
Percentage
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
ADT
AM Peak
PM Peak
Period
NEMC Phase 1-C
Parcel A
Parcel B
Parcel C

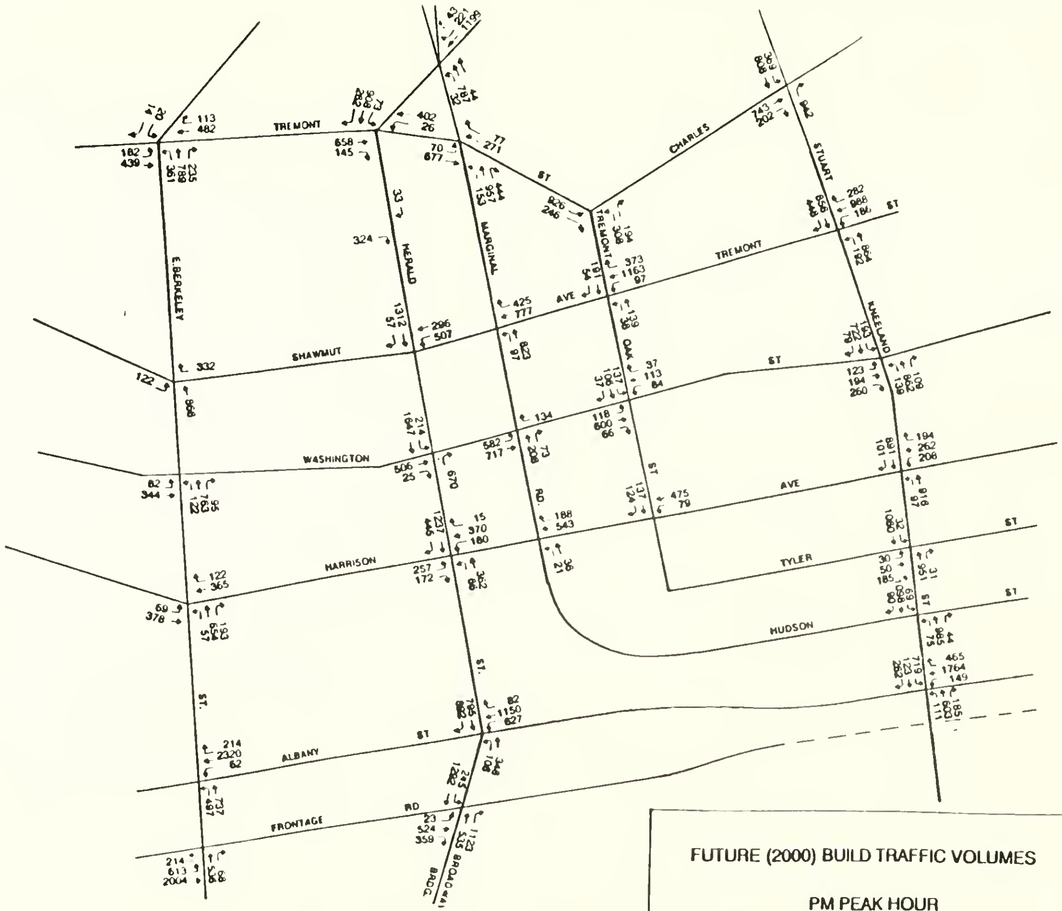


FUTURE (2000) BUILD TRAFFIC VOLUMES

AM PEAK HOUR

N

FIGURE 3.12



FUTURE (2000) BUILD TRAFFIC VOLUMES

PM PEAK HOUR

N

FIGURE 3.13

Table 3-7

Added Transit Trips by Station for NEMC and Other Study Area Projects: Year 2000

Use/Time Period	Total Transit Trips	NEMC	China-town	South Station	Downtown Crossing	Park	Boylston
% Usage:		69%	1%	5%	9%	3%	13%
NEMC Phase 1-C							
Daily	1327	916	13	66	119	40	173
AM Peak (inbound)	124	86	1	6	11	4	16
PM Peak (outbound)	130	90	1	7	12	4	17
Parcel A							
Daily	377	260	4	19	34	11	49
AM Peak (inbound)	23	16	0	1	2	1	3
PM Peak (outbound)	19	13	0	1	2	1	2
Parcel B							
Daily	320	221	3	16	29	10	42
AM Peak (inbound)	20	14	0	1	2	1	3
PM Peak (outbound)	16	11	0	1	1	0	2
Parcel C							
Daily	2487	1716	25	124	224	75	323
AM Peak (inbound)	106	73	1	5	10	3	14
PM Peak (outbound)	94	65	1	5	8	3	12

3.6 Parking Demand

The additional parking demand generated by the new trip generation of the study projects was estimated from the trip generation and mode split results, as follows:

- For commercial uses, the method utilized the all day (ADT) vehicle trip generation (after taking into account ridesharing, transit and walk trips) as it was divided into work and non-work categories. First the all day numbers, which represent all trips entering and leaving the site, were divided in two to obtain the total entering vehicles, both for work and non-work purposes.

  - Work Trip (Employee) Parking Demand: Each entering work vehicle was judged to require one all-day parking space. However, for the peak parking demand calculation, the total NEMC development trips were reduced by 30% to account for part-time workers, student schedules, and afternoon and night shift personnel.

  - Non-Work (Patient/Visitor) Parking Demand: Visitor parking was assumed to have a turnover rate of around 4.0 such that spaces used by non-work trips would be occupied by 4.0 different vehicles in the run of a day. This rate was based upon an average patient/visitor duration of under two hours[2], and the spread of these trips over a longer day than the typical eight hour work day (many visitor trips are made in the evening). The non-work turnover rate was varied slightly according to the nature of the component projects. For Parcel C, a lower turnover rate of 3.0 was assumed, to reflect a longer average duration of parking for recreation purposes.

  The results of this method of parking demand estimation are summarized in Table 3-8. As shown, parking demand for NEMC Phase 1-C North and South buildings comes to 310 spaces, of which 242 are for workers and 98 for visitors. For the Parcel C recreation center, parking demand comes to 253 spaces, primarily for visitor use.

- For the residential projects, a car ownership rate of .35 vehicles per dwelling unit was assumed, based on recent Chinatown survey data. It was also assumed, based on surveys of downtown Boston housing developments, that 80% of resident cars would stay parked all day, yielding a residential parking demand of 39 spaces for Parcel A and 34 spaces for Parcel B. These figures are compared against proposed parking supply for each project (which exceeds the demand) in Section 4, Impact Analyses.

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[2] Whitlock, E.M., Parking for Institutions and Special Events, Eno Foundation for Transportation, Inc., Connecticut (1982).

Table 3-8
NEMC/Chinatown Housing Parking Demand

	Work:		Nonwork:		Residential:			
	Round Trips (veh)	Work Parking Demand	Round Trips (Veh)	Turnover Rate	Number of D.U.	Cars per D.U.	Nonwork Parking Demand	Total Parking Demand
NEMC Phase 1-C								
North:								
Hospital	179	125	242	4.00	0	0	61	186
Research	56	39	30	4.00	0	0	7	47
Total	235	165	272				68	233
South:								
Hospital	75	53	102	4.00	0	0	25	78
Research	34	24	18	4.00	0	0	5	29
Total	109	77	120				30	107
TOTAL Phase 1-C:								
Hospital	254	178	344	4.00	0	0	86	264
Research	90	64	48	4.00	0	0	12	76
Total	344	242	392				98	340
Parcel A Housing	na	0	na	na	141	0.35	39	39
Parcel B Housing	na	0	na	na	120	0.35	34	34
Parcel C Recreation	7	7	738	3.00	0	0	246	253
Total	**351**	**249**	**1130**		**261**		**417**	**666**

Work/Non Work Breakdown (Percent of Total Daily Round Trips):

	Work %	Nonwork %	Comments
Hospital	42.5	57.5	70% attendance factor
Research	65.0	35.0	70% attendance factor
Housing	40.0	60.0	80% of resident cars left parked during the day
Recreation	1.0	99.0	
Hotel	15.0	85.0	
Retail	12.0	88.0	
Day Care	3.0	97.0	

Source: Table 3.1 (Person Trip Generation Rates)

4.0 IMPACT ANALYSES

4.1 Assumptions

The scope for this study requires a certain condition of No-Build traffic growth without specification of the related transportation system. On the other hand, analyses of the Build condition require evaluation of several system alternatives, e.g., with and without the Central Artery/Third Harbor Crossing (CA/T) project and with and without certain proposed changes in nearby Turnpike ramps. All this could lead to a confusing array of combinations of No-Build and Build analyses under different network conditions.

To provide a clear structure for this process, both the No-Build and Build analyses were done on the existing network as a base case. This base case was then evaluated for the effects that the other system alternatives would have, particularly on problem location. This allows a clear perspective on the effects that system changes will have on future access demand conditions.

On the issues of CA/T project and Turnpike ramp alternatives, it must be stressed at the outset that the number and combination of ramp layouts in and around the Study Area of this report are manifold and under the process of review and/or design. The determination and assessment of impacts and possible mitigation are the responsibility of the CA/T project and the Turnpike Authority, who are engaged in a continuing project development process. Analyses are ongoing and much work has, and is being done subsequent to the work done in this report. This study, of course, has its own context and focus. Within this, the CA/T and Turnpike ramp evaluation has validity, but differences and limitations with respect to the CA/T process must be acknowledged and kept in mind. An overview/retrospect section will be presented later with the Roadway Alternatives analyses to help guide the reader in this regard.

CA/T Project. This major undertaking involves the depression and widening of the Central Artery from Massachusetts Avenue to Charlestown plus the construction of a new Harbor tunnel as an extension of the Turnpike, routed through South Boston industrial land to Logan Airport in East Boston and beyond. This project entails of course the creation of new and the modification of old ramp connections. The purpose of the project is to give better service to growing major regional traffic flows while relieving local streets of significant arterial volumes. The hope for the Study Area is that certain types of traffic which now uses local streets to bypass Central Artery congestion will remain on the much improved regional system. One major feature of the CA/T affecting the Study Area is the creation of a southbound off-ramp leading into Marginal Road (with a branch also connecting to the Turnpike). Major traffic volumes using this connection could offset the intent of the Turnpike ramp changes noted below.

Turnpike Ramp Changes. In an effort to divert some traffic on local streets to the Turnpike while giving more immediate access to the regional system from the South End, Chinatown and Back Bay, and Back Bay, Turnpike ramp changes have been proposed. The most extensive changes would involve the creation of both an outbound off-ramp at Berkeley Street and an inbound on-ramp at Tremont Street, fed by an extension of Herald Street from Tremont west to Clarendon Street. The existing Arlington Street outbound ramp would have to be eliminated to allow the outbound off-ramp to Berkeley.

The effects of the proposed changes on Marginal Road and to a lesser extent on Herald Street are of greater local interest in the Study Area, as Marginal Road is immediately adjacent to Chinatown residential and school areas. As consideration of the total ramp changes evolved, the inbound ramp from Tremont Street with the Herald Street extension have been eliminated from planning due to physical feasibility (passage over railroad tracks, etc.) and funding restraints. Only the outbound ramp proposal to Berkeley Street is now being considered, and it is this alternative which is being evaluated in this report. The expectations here would be in the reduction of westbound traffic only on local streets, notably Marginal Road. This ramp proposal is being (comprehensively) assessed by the Turnpike Authority in an Environmental Impact Report.

4.2 Year 2000 No-Build Impacts - Base Case Vehicular

Levels-of Service (LOS) analyses were performed for the AM and PM peak hour for the (year 2000) No-Build traffic volumes described under Future Trip Generation and shown in Figures 3.8 and 3.9, above. As noted above, these were performed under existing roadway conditions as the base case. The results of this analysis work are shown in Table 4.1.

It can be seen that six intersections operate at unacceptable LOS (less than LOS D) during either or both peak hours, four more than under existing (1989) conditions. The unacceptable locations are:

	Intersection	Peak Hour	1989 LOS	2000 No-Build LOS
1.	Stuart/Tremont	AM	B	E
	"	PM	B	F
2.	Kneeland/Harrison	PM	D	F
3.	Kneeland/Surface Artery	PM	D	F
4.	Herald/Albany	PM	D	F
5.	Herald/Frontage/ Broadway Bridge	AM	F	F
	"	PM	D	F
6.	E. Berkeley/Frontage/ W. Fourth	AM	F	F

Table 4.1
No-Build Level of Service (LOS) Analysis Summary

	AM Peak Hour			PM Peak Hour		
Location	LOS	Average Delay	V/C	LOS	Average Delay	V/C
Stuart/Tremont	E	57 sec	1.21	F	531 sec	1.87
Kneeland/Washington	C	19 sec	1.00	D	35 sec	1.17
Kneeland/Harrison	C	19 sec	0.90	F	99 sec	1.22
Kneeland/Tyler	B	8 sec	0.75	D	29 sec	1.05
Kneeland/Hudson	C	14 sec	-	D	23 sec	-
Kneeland/Surf. Art.	D	34 sec	1.02	F	144 sec	1.27
Oak/Tremont	B	8 sec	0.35	B	9 sec	0.67
Oak/Washington	B	11 sec	0.63	B	12 sec	0.71
Oak/Harrison	A	6 sec	-	D	22 sec	-
Marginal/Arlington	B	7 sec	0.31	B	9 sec	0.57
Marginal/Tremont	B	12 sec	0.73	B	14 sec	0.86
Marginal/Shawmut	B	10 sec	0.48	B	13 sec	0.77
Marginal/Washington	A	3 sec	0.45	B	7 sec	0.45
Marginal/Harrison	A	4 sec	0.16	A	3 sec	0.34
Herald/Tremont	B	12 sec	0.63	B	11 sec	0.58
Herald/Shawmut	B	10 sec	0.50	B	15 sec	0.80
Herald/Washington	B	11 sec	0.74	B	12 sec	0.77
Herald/Harrison	B	13 sec	0.75	D	27 sec	1.02
Herald/Albany	C	20 sec	0.91	F	114 sec	1.23
Herald/Frontage & Broadway	F	237 sec	1.51	F	136 sec	1.36
E.Berkeley/Tremont	D	26 sec	1.03	C	16 sec	0.79
E.Berkeley/Shawmut	B	6 sec	0.50	B	9 sec	0.47
E.Berkeley/Washington	B	8 sec	0.62	B	9 sec	0.48
E.Berkeley/Harrison	B	13 sec	0.83	B	11 sec	0.83
E.Berkeley/Albany	C	19 sec	0.92	C	17 sec	0.89
E.Berkeley/Frontage & W. Fourth	F	1065 sec	1.48	D	28 sec	1.02

4.3 Year 2000 Build Impacts - Base Case Vehicular

The year 2000 vehicular traffic volumes (Figures 3.8 and 3.9) developed in the last chapter were subjected to LOS analyses on the existing roadway network, with the results shown in Table 4.2. No intersections experienced LOS deficiencies that were not evident in the No-Build LOS results, although delay was increased at the previously identified locations. Figure 4-1 compares AM and PM peak hour intersection LOS under Existing, No-Build and Build conditions.

The impacts of the Build condition have to be viewed relative to the No-Build to ascertain the extent to which the projects under study create any future traffic traffic problems. In this case, if only the proposed projects under this report were built, the traffic conditions would not change perceptibly beyond existing conditions, where only two intersections are at unacceptable LOS, and that only in the AM peak hour (Herald/ Frontage/ Broadway and E. Berkeley/ Frontage/ W. Forth). Given the magnitude of existing traffic levels and the much larger No-build growth, the projects of this report are relatively minor traffic contributors. This is discussed further below in Section 4.12, Impact Perspective.

4.4 Context of Roadway Alternatives Analyses

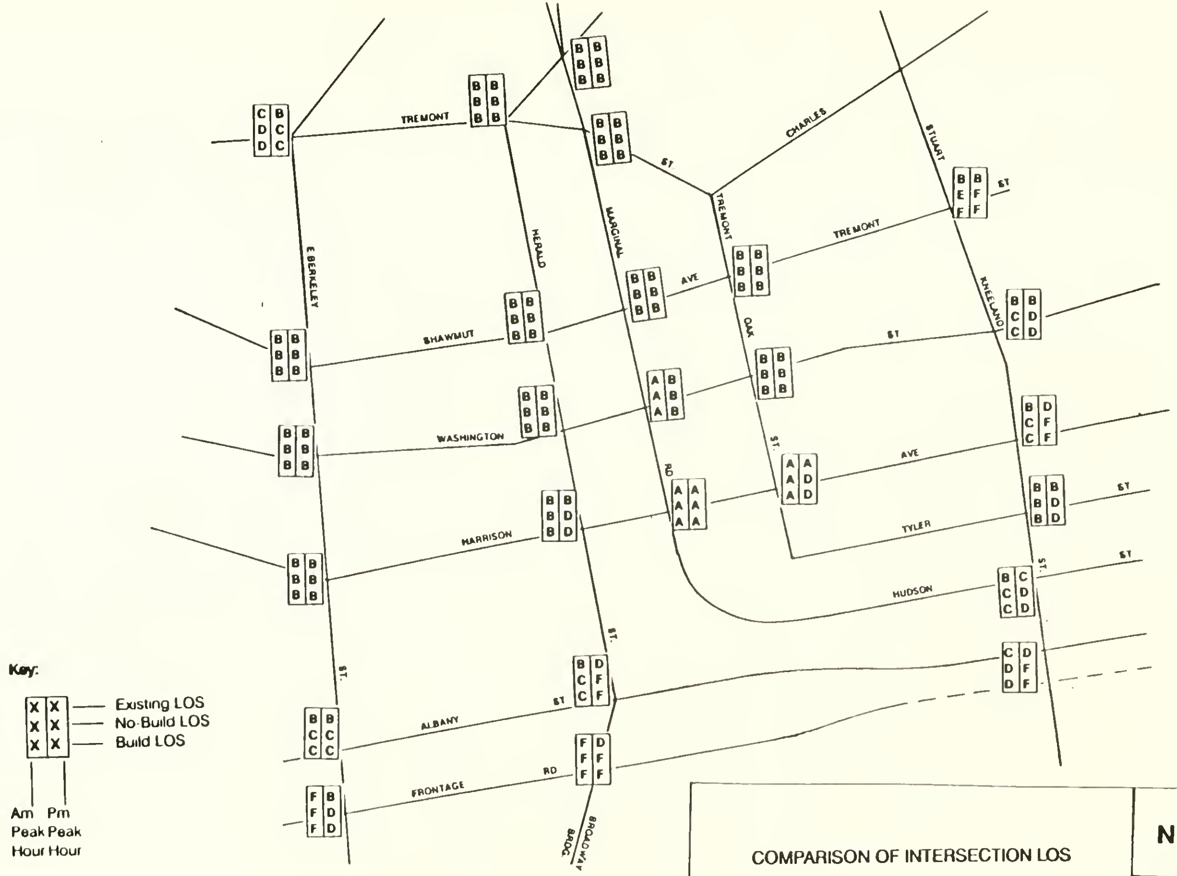
As noted at the beginning of this chapter, the roadway alternatives involve the effects of the CA/T project and a related proposed building of Turnpike ramp(s). These actions are the responsibility of State and Federal agencies who have an ongoing process related to these alternatives. This study was not intended to be a major actor in the CA/T development process, but rather to concentrate on the development proposals and local access requirement, while giving some perspective to the effects of regional actions being determined by a decision process involving many more interests.

The alternative analysis work in this study was done at a point in time in advance of the CA/T Final Environmental Impact Statement (FEIS), based on information available. Meanwhile, voluminous new (or updated) work was done by the CA/T project for the FEIS. Nevertheless, within its context, the alternatives discussion of this present report has validity. This context varies from CA/T FEIS and related work in the following respects:

- One CA/T scheme is used to assess the CA/T effect on the Study Area, looked at with and without new Turnpike ramps to/from the Back Bay. This basic scheme included all ramp connections to Marginal Road. It was not part of this work to consider a series of CA/T project variations in and around Chinatown.
- The analysis time frame for this study is different (Year 2000) than for the CA/T project (Year 2010).

Table 4.2
Future Build Level of Service (LOS) Analysis Summary

	AM Peak Hour			PM Peak Hour		
Location	LOS	Average Delay	V/C	LOS	Average Delay	V/C
Stuart/Tremont	F	67 sec	1.24	F	601 sec	1.96
Kneeland/Washington	C	21 sec	1.02	D	37 sec	1.18
Kneeland/Harrison	C	20 sec	0.90	F	101 sec	1.23
Kneeland/Tyler	B	8 sec	0.76	D	30 sec	1.05
Kneeland/Hudson	C	14 sec	-	D	25 sec	-
Kneeland/Surf. Art.	D	36 sec	1.03	F	150 sec	1.27
Oak/Tremont	B	8 sec	0.35	B	9 sec	0.68
Oak/Washington	B	11 sec	0.64	B	12 sec	0.72
Oak/Harrison	A	6 sec	-	D	22 sec	-
Marginal/Arlington	B	7 sec	0.31	B	10 sec	0.58
Marginal/Tremont	B	12 sec	0.74	B	15 sec	0.88
Marginal/Shawmut	B	10 sec	0.50	B	14 sec	0.79
Marginal/Washington	A	4 sec	0.47	B	7 sec	0.48
Marginal/Harrison	A	4 sec	0.17	A	3 sec	0.36
Herald/Tremont	B	13 sec	0.67	B	11 sec	0.59
Herald/Shawmut	B	10 sec	0.51	B	16 sec	0.86
Herald/Washington	B	12 sec	0.76	B	14 sec	0.80
Herald/Harrison	B	13 sec	0.76	D	33 sec	1.06
Herald/Albany	C	20 sec	0.91	F	132 sec	1.27
Herald/Frontage & Broadway	F	238 sec	1.51	F	142 sec	1.36
E.Berkeley/Tremont	D	28 sec	1.03	C	16 sec	0.79
E.Berkeley/Shawmut	B	6 sec	0.52	B	9 sec	0.48
E.Berkeley/Washington	B	8 sec	0.63	B	9 sec	0.49
E.Berkeley/Harrison	B	13 sec	0.84	B	11 sec	0.62
E.Berkeley/Albany	C	20 sec	0.94	C	18 sec	0.90
E.Berkeley/Frontage & W. Fourth	F	1077 sec	1.51	D	28 sec	1.02



COMPARISON OF INTERSECTION LOS

FIGURE 4.1

- The traffic volume changes for this report are based upon total traffic approaching each intersection studied, while volumes reported in CA/T work are usually for individual roadway segments. Thus, the comparison of numbers in this report and in CA/T work is to be avoided because of analysis year and traffic volume type differences.

- The summary of effects in this study considers locations throughout the Study Area, while CA/T focus is more specifically on Marginal Road.

Within the above limitations, this study confirms certain aspects of the CA/T actions with respect to the local situation.

Overview/Summary of CA/T Effects

In broad terms, the CA/T project simply provides more expressway capacity in its corridor, partly by Artery widening, and partly by linking to a new Harbor Tunnel to the Airport and beyond, as a diversion to Downtown roadways. It would be expected that the project would generally reduce extraneous traffic on local streets in the general corridor. The study shows that, overall, such is the case if the area (bounded by E.Berkeley, Tremont, Kneeland, and Albany Streets) is viewed as a whole.

On the other hand, where connections to a new expressway facility are are focused on particular local streets, greater traffic volumes will occur. In the CA/T project, ramp connection from the project focus upon Marginal Road, where increases in traffic exceed general growth. The CA/T layout and ramp arrangement eliminate the existing Beach Street I-93 southbound offramp, replacing it in effect by the link to Marginal (via Ramp M). In addition, the new Harbor Tunnel/Seaport Access Road westbound (via Ramp DD) plus I-93 northbound (via Ramp KD) connect into Marginal Road for access to the area. Traffic volumes on Marginal are of course higher, by a greater degree with all the links in place, as is the case in the analyses of this report.

The extent of the increase is seen in the section of Marginal east of Washington, where the existing street layout protects the street from direct access from other arterials. The existing layout feeds the section west of Washington Street as part of a one-way pair with Herald Street across the Turnpike, so that future continuing arterial use of this section is less marked. The analysis in this report only contains the intersection of Marginal and Shawmut as an indicator. Thus the increases for Marginal do not appear as dramatic as they would further east. The conclusion is clear (notably in the AM peak when traffic is dominantly inbound), however, the CA/T as proposed would make Marginal arterial in nature for its full length, instead of just west of Washington, where heavier usage is evident today.

The proposal to have an outbound Turnpike connection to the Back Bay via a new ramp to Berkeley Street should to provide some relief to Marginal. The analysis contained herein, however, indicates that this would be limited. The reason for this is that because certain traffic diverts to the Turnpike, other vehicle trips find Marginal more attractive and re-route from yet other roadways. The CA/T FEIS shows that the relief effect of the new Turnpike ramp is more evident on Marginal west of Shawmut Avenue.

The following analyses are in consonance with the above discussion, even though derived from somewhat earlier CA/T traffic network assignments. The assignment process is often very sensitive to slight changes, but the end conclusion seems to be that, with or without the new Turnpike ramp(s), the section of Marginal Road east of Washington will become arterial in nature like that to the west if the CA/T project is connected as planned. One offsetting feature will be the protection of Hudson Street.

If connections to Marginal are reduced or eliminated, it would be expected that traffic on Essex, Kneeland, Herald and East Berkeley Streets would have to carry the displaced volumes.

Description of Roadway Alternatives

The alternative roadway conditions being considered involve the addition of the planned major Central Artery/Third Harbor Crossing (CA/T) project and/or a modification of Turnpike ramp connections which could affect the Study Area. The projects are as follows:

CA/T Project. This major undertaking involves the depression and widening of the Central Artery from Massachusetts Avenue to Charlestown plus the construction of a new Harbor tunnel as an extension of the Turnpike, routed through South Boston industrial land to Logan Airport in East Boston and beyond. This project entails of course the creation of new and the modification of old ramp connections. The purpose of the project is to give better service to growing major regional traffic flows while relieving local streets of significant arterial volumes. The hope for the Study Area is that certain types of traffic which now uses local streets to bypass Central Artery congestion will remain on the much improved regional system. One major feature of the CA/T affecting the Study Area is the creation of a southbound off-ramp leading into Marginal Road (with a branch also connecting to the Turnpike). Major traffic volumes using this connection could offset the intent of the Turnpike ramp changes noted below.

Turnpike Ramp Changes. In an effort to divert some traffic on local streets to the Turnpike while giving more immediate access to the regional system from the South End, Chinatown and Back Bay, and Back Bay, Turnpike ramp changes have been proposed. The most extensive changes would involve the creation of both an outbound off-ramp at

Berkeley Street and an inbound on-ramp at Tremont Street, fed by an extension of Herald Street from Tremont west to Clarendon Street. The existing Arlington Street outbound ramp would have to be eliminated to allow the outbound off-ramp to Berkeley.

The effects of the proposed changes on Marginal Road and to a lesser extent on Herald Street are of greater local interest in the Study Area, as Marginal Road is immediately adjacent to Chinatown residential and school areas. As consideration of the total ramp changes evolved, the inbound ramp from Tremont Street with the Herald Street extension have been eliminated from planning due to physical feasibility (passage over railroad tracks, etc.) and funding restraints. Only the outbound ramp proposal to Berkeley Street is now being considered, and it is this alternative which is being evaluated in this report. The expectations here would be in the reduction of westbound traffic only on local streets, notably Marginal Road. This ramp proposal is being (comprehensively) assessed by the Turnpike Authority in an Environmental Impact Report.

4.5 Effects of Roadway Alternatives

Alternative Analysis Methodology. To obtain a measure of the effect of the CA/T project and/or the Turnpike ramp changes on the Study Area, a method was devised to indicate at key intersections how the two proposals affected traffic volumes relative to the base case year 2000 Build conditions. This was done by comparing the results of traffic model (TRANPLAN) roadway network assignments done as part of a study of Back Bay traffic by Cambridge Systematics Inc. (CSI) for the City of Boston, but derived directly from a larger model developed also by CSI for CA/T future traffic analysis purposes. The assignments referred to fortunately included the Study Area, and included all proposed development projects to the target year 2010, projected from a base year 1987.

Since this study has a base year 1987 and a future target year 2000, the network assignments (1987 & 2010) had to be adapted to this shorter period. It was decided to use a relative growth factor method for comparisons of base case growth with growth in association with network assignments with the CA/T and Turnpike ramp changes. Assignments comparing total approach volumes at 16 of the 27 Study Area intersections on the existing network with year 2010 volumes with the CA/T were further compared with the changes estimated in the base case of this report. The number of intersections used was limited by the nature of the traffic assignment output.

To make the time periods comparable, an annual (compound) growth rate was calculated for the change in assignments and projected over 13 years to the target year 2000. Comparison of the changes in intersection volumes with and without the CA/T show the extent to which the CA/T project relieves each intersection. Variants with and without the Turnpike ramp changes allow further evaluation of these changes at each intersection. In essence, growth factors in total intersection approach volumes were calculated and compared for the following conditions, after adjusting to the common future year of 2000:

"Present" Conditions	"Future" Conditions	Approach Volume Sources
1. 1989 existing roads	Base Build, No CA/T	1989 counts, 2000 Build
2. 1987 network	2010 network, CA/T only	1987, 2010 assignments
3. 1987 network	2010 network, CA/T and Turnpike Ramp change	1987, 2010 assignments

It should be pointed out that this method is not a precise tool, but the overall results should give an indication of real differences. Growth factor comparison was done as absolute values were not directly comparable between assignments and other volume sources. In addition, since changes at any given location can result from either a difference in volume demand and changes in the system, the proration of assignment changes to the common future year may not be totally valid, as either the physical changes are in or not, apart from the volume demand factors. Limitations in the availability of actions of assignments hampered compensating for this effect. Despite this caveat (with respect to "apples and oranges"), it is felt that the results are of use in evaluating CA/T and Turnpike ramp change effects.

Effects of Alternatives. The results of the analysis can be seen in Figure 4.2 and 4.3 which present a comparison of the total estimated AM and PM peak hour approach volumes at 16 intersections for all future alternatives - no CA/T, CA/T only, and CA/T with the Turnpike intersections for all future alternatives - no CA/T, CA/T only, and CA/T with the Turnpike ramp change. It can be seen that the effect varies from intersection to intersection, but that, overall the CA/T project provides a volume reduction on the average, with a smaller further, but more limited, reduction evident with the Turnpike ramp change.

The results can be seen in aggregate in Figures 4.4 and 4.5 expressed as a multiple of the total existing counted approach volumes at the 16 intersections for the AM and PM peak hours. This shows the relative changes in total demand for the conditions shown. The following table expresses these changes as a ratio to existing counts.

	Ratio of Change to Existing Counts	
Condition	AM Peak Hour	PM Peak Hour
Existing Counts (1989)	1.00	1.00
No-Build	1.24	1.24
Build	1.26	1.26
Build with CA/T	1.02	1.06
Build with CA/T & Tpke.Ramp	1.02	1.02

Although it may be violating the limits of precision, a look at the changes which the alternative conditions cause at the intersections which experience Build LOS worse than D is of interest.

Intersection	Peak Hour	Build LOS	% Volume Reduction from CA/T	CA/T +Tpke.Ramp
Stuart/Tremont	AM	F	- 6%	-10%
Stuart/Tremont	PM	F	-15	-21
Kneeland/Harrison	PM	F	-16	-20
Kneeland/Surface Artery	PM	F	-21	-19
Herald/Frontage/Broadway	AM	F	na	na
Herald/Frontage/Broadway	PM	F	na	na
Herald/Albany	PM	F	-21	-28
E. Berkeley/Frontage/W. 4th	AM	F	-34	-20

The above table indicates that all intersections experience a reduction in traffic demand from the Artery project, ranging from 6% up to 34%. While these reductions may not in all cases be able to bring the LOS into the acceptable range, conditions should improve markedly by the implementation of the CA/T project. The further reduction by the Turnpike ramp change is relatively minor, particularly in the AM peak hour. And, at two intersections, the ramp proposal reduces traffic less than the case of the CA/T alone. At Kneeland/Surface Artery, the ramp proposal reduces traffic by 19% over base year levels, compared to 21% for the Artery project alone. At E. Berkeley/Frontage/W. Fourth Street, the ramp proposal reduces traffic by 20%, compared to 34% with the CA/T project alone.

An overview of the ability of the alternatives to relieve future traffic enough to produce acceptable LOS may be obtained by remembering that most of the unacceptable LOS were brought about by the No-Build growth of about 24% (corresponding to the 1.24 ratio above), while overall levels, including project contributions were reduced to within only 2%-6% above existing (corresponding to the 1.02 and 1.06 ratios above). In general terms, it may be concluded from the above that the CA/T project will go far in restoring traffic LOS to reasonable levels. It is felt that the probable lack of precision in the individual intersection percentages does not warrant precise recalculation of specific LOS. The individual values show that there will be variability in effect, as would be expected, even though the overall outlook shows improvement.

Comment on Marginal Road and Herald Street. The proposed Turnpike ramp changes were in part motivated by a desire to relieve traffic on Marginal Road and Herald Street. Based upon observing a number of network traffic assignments with and without one or other of the two originally proposed ramps, the traffic relief observed was minor at best for both roadways. The main reason for this is that although the new ramps attracted

Figure 4.2

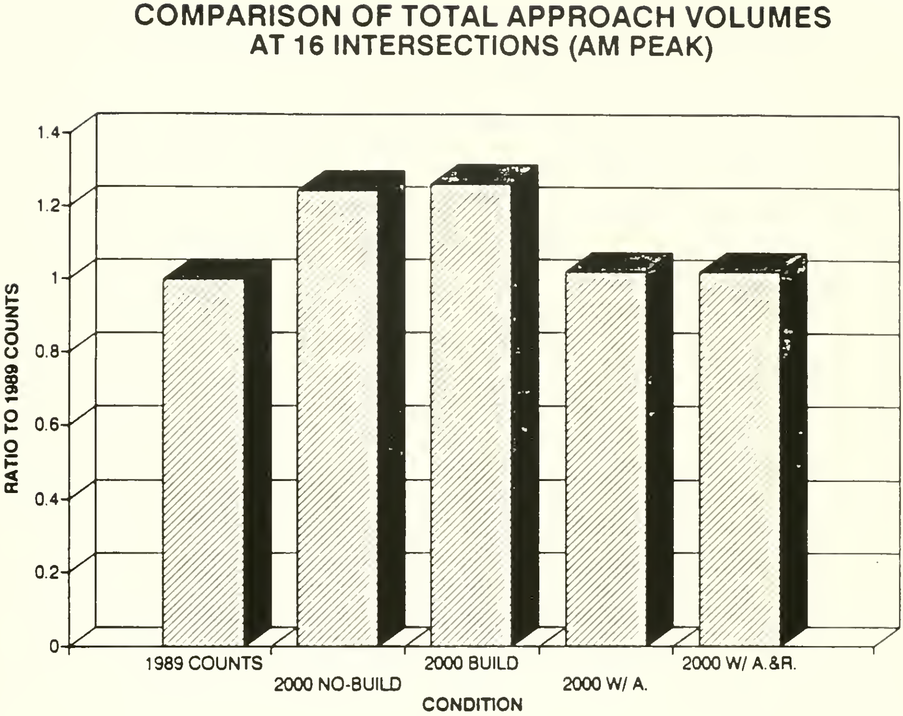
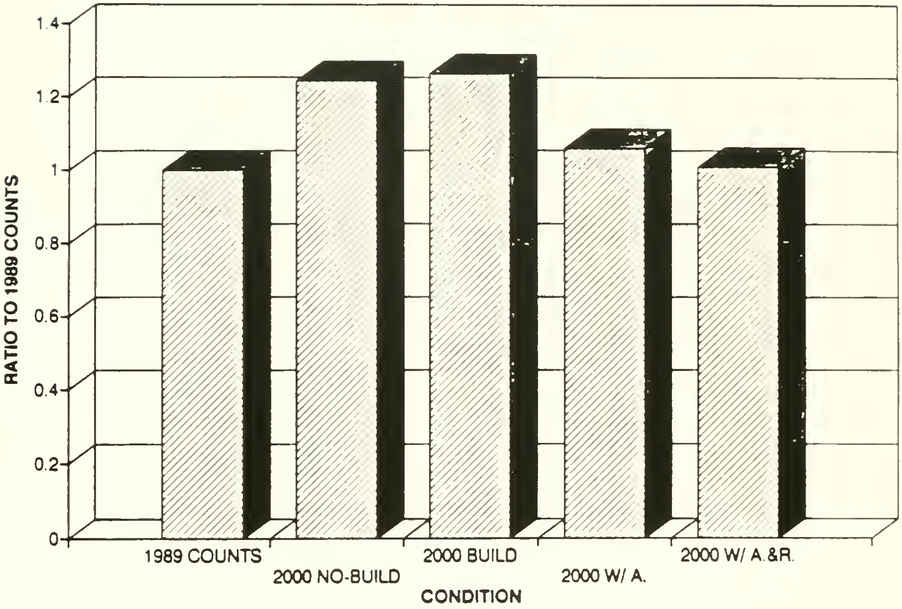
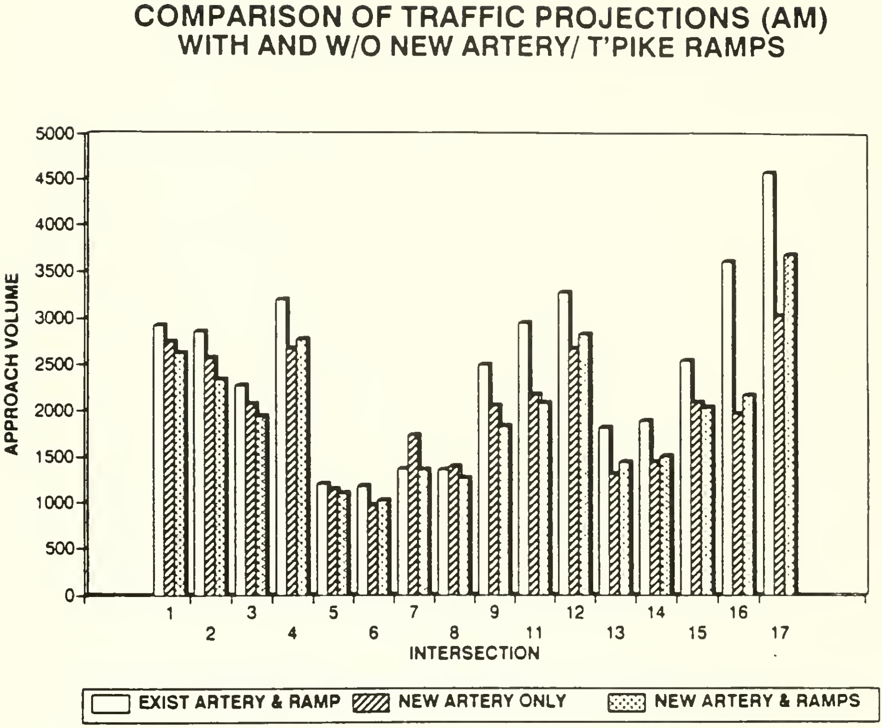

COMPARISON OF TOTAL APPROACH VOLUMES AT 16 INTERSECTIONS (AM PEAK)
RATIO TO 1989 COUNTS
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1989 COUNTS
2000 NO-BUILD
2000 BUILD
2000 W/ A.
2000 W/ A.&R.
CONDITION

Figure 4.3



COMPARISON OF TOTAL APPROACH VOLUMES AT 16 INTERSECTIONS (PM PEAK)

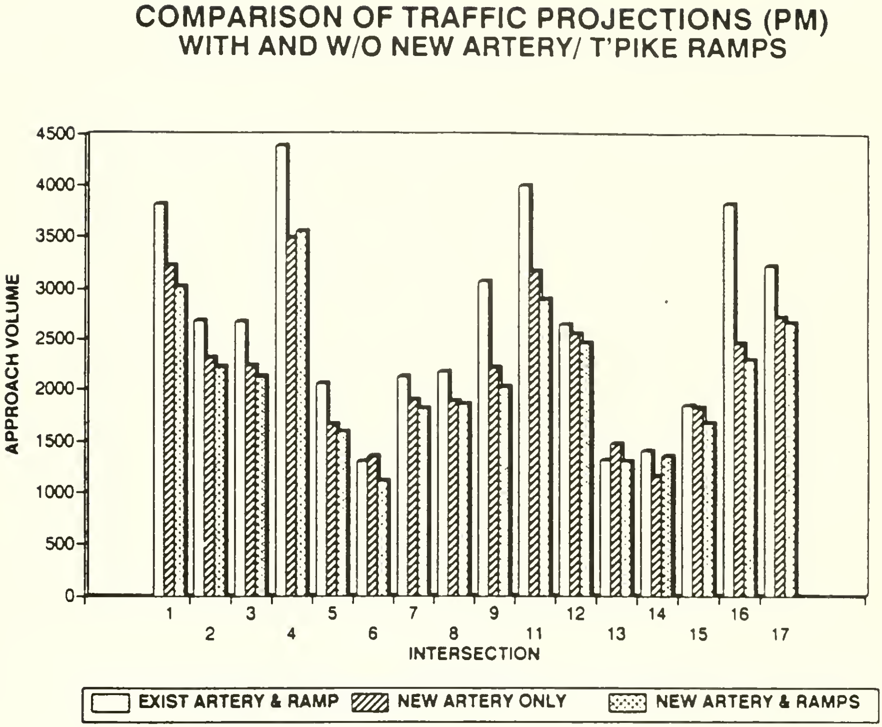
Figure 4.4



KEY:

1- Stuart/Tremont
2- Kneeland/Washington
3- Kneeland/Harrison
4- Kneeland/Surface
5- Oak/Tremont
6- Oak/Washington
7- Marginal/Shawmut
8- Herlad/Shawmut
9- Herald/Washington
10- Herald/Albany
11- E.Berkly/Tremont
12- E.Berkly/Shawmut
13- E.Berkly/Washington
14- E.Berkly/Harrison
15- E.Berkly/Albany
16- E.Berkly/Frontage & Fouth

Figure 4.5



KEY:
1- Stuart/Tremont
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3- Kneeland/Harrison
4- Kneeland/Surface
5- Oak/Tremont
6- Oak/Washington
7- Marginal/Shawmut
8- Herlad/Shawmut
9- Herald/Washington
10- Herald/Albany
11- E.Berkly/Tremont
12- E.Berkly/Shawmut
13- E.Berkly/Washington
14- E.Berkly/Harrison
15- E.Berkly/Albany
16- E.Berkly/Frontage & Fouth

considerable traffic, much of it was diverted traffic from routes outside of the Study Area, leaving volumes on Marginal and Herald close to the situation with the existing ramp arrangement. The ramps apparently serve their other purpose of providing a better route for traffic to the expressway system very well.

Since the inbound on-ramp from Tremont Street with the Herald Street extension is no longer a valid proposal, relief to Herald Street will not be addressed through this change. It is therefore fitting to concentrate more on the outbound off-ramp to Berkeley Street, which should relieve Marginal Road. The main reason why relief is minimal appears to relate to the fact that a new Artery southbound ramp connection feeds directly into Marginal, which is not the case with the existing ramp configuration. The closest corresponding existing Artery ramp is the southbound off ramp to Beach Street/Surface Artery adjacent to Chinatown. The conclusion to be reached here is that the new ramp connection to Marginal increases traffic on Marginal, and that the provision of the new Turnpike ramp attracts much traffic from other routings outside of the Study Area. This analysis indicates that due to the Marginal Road ramp from the Artery, the effects of the Turnpike ramp change are minimal. Whether or not the EIR being undertaken on the Turnpike ramp comes to similar conclusions remains to be seen.

4.6 Other Traffic Impact Issues

Several other traffic impact issues are associated with the NEMC Phase 1-C development and the proposed Chinatown housing developments, as discussed below. These are local in nature and more confined in effects than the large and more "global" Central Artery and Turnpike issues discussed above.

Moving of Ambulance Entrance

As part of the NEMC 1-C building program, the NEMC ambulance entrance will be moved from Harrison Avenue to Washington Street, as shown in Figure 3.7, above. Ambulance activity at the current entrance on Harrison Avenue represents about 25 vehicles per day. An AM and PM peak period count conducted for this study at Harrison Avenue and Oak Street showed only two ambulances in the PM peak hour, and none in the AM peak hour. Of course, it is impossible to predict the exact times and frequency of ambulance activity. The major impact of moving the entrance will be positive in that the entrance will be removed from a block with some residences to a block with no residences. This issue will be more fully addressed in the Project Impact Report for the 1-C development.

Moving of Maternity Entrance

To accommodate 1-C construction activity, the drop-off area and entrance for maternity admissions (in the existing hospital space) will be temporarily moved to the pediatric entrance of Floating Hospital on Washington Street. Temporary parking for 6-8 cars will be available. This arrangement will last only until 1-C is completed.

Alternative Parking Access for Chinatown Housing Parcels

Two issues exist in the possible parking alternatives for Chinatown Community projects:

- o The extent to which parking resources may be shared, and
- o What parking entrance/exit arrangements are best.

It should be first observed that at the present time, no parking is planned for Parcel C, the Community Center, on the premise that, due to the function of the Center, most users would gain access by walking from the community. This is probably substantially true, even though for project travel estimation purposes up to 92 vehicle arrivals and departures have been estimated in the larger (PM) peak hour. This was done to make sure that total project vehicle access is not understated. Some minimum parking arrangements should be made available, either by on-site addition, or by sharing nearby parking facilities, such as that available to Parcels A and B, the Community Housing developments.

Parcels A and B comprise a total of 261 housing units served by a planned 250 parking spaces. Based on the 1980 Census indication that Chinatown residents own 1 car for every 3 residences (See Section 2.2), it is possible that the parking demand for the proposed housing could be as low as about 90 cars, although 250 spaces (almost one per unit) are proposed. And, as shown in Table 3.8, with an estimated 80% occupancy in the daytime, peak period demand would be only 73 cars. Even if evening demand increased to double this amount, or 180 spaces, there would still be up to about 70 spaces available for sharing with the Community Center. In the daytime, from 100-170 spaces would be available for potential sharing with NEMC. For the security and convenience of the residents, however, this would have to be done on a very controlled basis.

For optimum space deployment, it is desirable to have internal connections between the Parcel A and B garages, or have the parking designed into what is effectively one garage. (It has already been determined that connecting to an underground garage under Parcel C is infeasible due to high utility relocation costs.) Any Parcel A and B garage connections will also have to be decided on cost and underground utility disruption factors in the final design phase. If the 250 spaces can be integrated, one entrance/exit location is adequate, otherwise, two would of course be necessary. Two arrangements are proposed:

1. If the parking is divided, Parcel A should provide access from Marginal Road, and Parcel B, from Washington Street. These are both major streets providing access via "round the block" circulation, and the locations relate directly to each site served. Due to the one-way nature of Marginal Road and the physical median in Washington Street, only right turns in and out would be possible at each driveway.

2. If the parking is combined, one driveway from Washington Street, more centrally located to both sites, would be adequate.

Spaces within the garage(s) should be specifically assigned to residents in clearly defined areas, with any excess spaces set aside for visitors and possible shared parking in separate sections. The provision of spaces to acceptable outside users on a leased basis would naturally generate revenues for the housing.

4.7 Parking Conditions

The question of expanded parking capacity to meet the needs of the Medical Center has been under consideration for several years and has been the subject of intense community interest. Several on-site and off-site alternatives for increasing Medical Center parking supply were the subject of the 1986 Parking Needs and Site Evaluation Study conducted for NEMC by Vanasse Hangen and referenced elsewhere in this report. The alternatives analysis is well documented in the 1986 report, and so is not repeated here.

Since that study, an extensive community participation process has occurred, and agreements have been reached with Chinatown neighbors regarding usage of parcels within the Medical Area formerly proposed for parking, as well as acceptable fringe parking options.

In the proposal around which consensus has been reached, New England Medical Center has agreed to a land exchange whereby land on Parcels A, B, and C can be used by Chinatown development interests for housing, as outlined above. To meet parking needs, NEMC is seeking to enter into an arrangement for continued leasing of parking spaces in the Herald Street Garage. Under discussion with the BRA and the current owner of the garage is a proposal to provide employee and student parking in a newly built and expanded facility, with provisions for use by the adjacent Castle Square residential tenants.

The Boston Redevelopment Authority recently approved the sale of Castle Square upon expiration of its initial development agreements with the City. Under this agreement, the garage will remain under its present ownership. As proposed, the new garage would be built on the site of the existing 400-car garage, at Herald Street between Shawmut Avenue and Paul Street. Under the current agreement, the expanded garage would include 650 spaces for the Medical Center and 150 spaces for residents of the adjacent Castle Square development. At this time, there is no specific garage design. Following resolution of the land transfer action being sought at this time, the design of the garage will be subject to the

state and city's review processes. For purposes of analysis, apart from the proposed size, an assumption has been made that the garage entrance and exit would remain on Herald Street as they are today. However, several different options, dependent upon the design process, have been discussed. In addition, other sites south of the Turnpike have have been considered for NEMC parking subsequent to the analyses performed for this study, as discussed in the Appendix.

It is noteworthy that the existing garage has several structural problems. Although only twenty years old, major sections of the roof level have had to be replaced. Future maintenance costs to deal with continuing deterioration will likely be high.

Overall NEMC Parking Supply and Demand

In terms of parking supply and demand, the proposed garage will basically replace parking to be lost at NEMC as buildings are constructed on parking lot sites, and leases with private operators are not continued. NEMC parking in an 800 car facility would include the following groups of parkers:

-	Existing parkers (staff/students):	400 spaces
-	Employee parking displaced by 1-C:	
	- Washington St. lot (evening shift only):	60 spaces
	- Oak Street lot:	70 spaces
-	New parking to meet 1-C expansion needs:	120 spaces
-	Castle Square tenant parking:	150 spaces
	Total	800 spaces

As shown above, the garage expansion would accommodate only 120 spaces for NEMC Phase 1-C expansion, compared to an estimated demand of 340 spaces, of which 242 are for employees and 98 for visitors. Visitor parking, however, would not be accommodated at this fringe facility in any event, but would be accommodated in the existing Tremont Street Garage and Harrison Avenue lot. In addition, the 60 spaces in the Washington Street lot are reserved today for evening shift workers only, and would more conveniently be replaced within the medical area rather than in a fringe facility. Thus, about 60 additional spaces will be available at Herald Street to meet daytime employee demand generated by 1-C, for a total of 180, which comes close to meeting the employee demand.

As proposed, the Herald Street Garage would also contain 150 spaces reserved for use by Castle Square residents. Today, Castle Square has approximately 294 on-site parking spaces (267 off-street in surface lots and 27 metered spaces along the Tremont Street service road) to serve its 500 dwelling units and 53,000 square feet of commercial space. Adding an additional 150 residential spaces in the garage would bring the total spaces to 444, or .89 spaces per unit.

Parking Freeze Issues

Phase 1-C development will displace 130 spaces in the Washington and Oak Street lots. These spaces are currently restricted to NEMC staff use and are not "commercial spaces" as currently defined in the City of Boston Parking Freeze regulations. Similarly, the proposed new spaces in the Herald Street Garage would not be open to the general public for a fee at any time, and would not qualify as "commercial spaces" under the freeze. Thus, the Herald Street Garage expansion project would not require a Parking Freeze Permit from the City of Boston Air Pollution Control Commission, although it would be necessary to file for an exemption on the grounds that the spaces are for employees and students only and are clearly not open to the public.

4.8 Transit Impacts

The increased numbers of transit riders attributable to NEMC Phase 1-C and the Chinatown developments are insignificant in terms of MBTA peak period carrying capacity, and will not impose an undue burden on any of the MBTA's rapid transit, commuter rail, or bus lines or stations. The highest volumes to be generated in the peak period by Phase 1-C development would be 130 total transit trips in the PM peak hour, distributed among all lines. Ninety of these trips would use the NEMC station, to access the Orange Line directly or to use the Orange Line and then transfer to other lines.

Ridership by line and direction was estimated through applying the trip distribution for commuter rail and subway riders to the overall transit ridership estimates presented in Table 3.5, as shown in Table 4.3 below. As shown, the maximum ridership on any one line is is on the Orange Line north, with 16 riders per hour in the peak direction in the PM peak hour.[1] This represents only around one tenth of one carload of people per hour, compared to a peak hour capacity of 78 Orange Line cars combined into 14 trains in the PM peak, capable of carrying over 12,000 people, as shown in Table 4.4 and 4.5. Thus, there is no noticeable impact on transit capacity on any line.

4.9 Pedestrian Impacts and Nassau Street

Similarly, the proposed projects will not add undue pedestrian travel to study area sidewalks and crosswalks. As shown in Table 3.3, Total Person Trip Generation, the NEMC project will add about 370 person trips in the morning and about 400 person trips in the evening, all of whom will be pedestrians at some point in their commute, whether walking from a transit station, a bus stop, or a parked car. Only a few -- around 25 in the morning and 25 in the evening -- will walk exclusively as a commute mode, however.

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[1] (Note: Green line west ridership of 18 people in the PM peak is spread among the four Green Line branches.)

Table 4.3
Estimated NEMC Phase 1-C Transit Ridership by Line and Direction

	Daily Riders		AM In		PM Out	
Transit Mode	Number	%	Number	%	Number	%
Total Transit	**1,327**	**100.0%**	**124**	**100.0%**	**130**	**100.0%**
Subway:	**929**	**70.0%**	**87**	**70.0%**	**91**	**70.0%**
Orange Line South	111	8.4%	10	8.4%	11	8.4%
Orange Line North	168	12.7%	16	12.7%	16	12.7%
Red Line North	118	8.9%	11	8.9%	12	8.9%
Red Line South: Ashmont	76	5.7%	7	5.7%	7	5.7%
Red Line South: Braintree	106	8.0%	10	8.0%	10	8.0%
Green Line West	197	14.8%	18	14.8%	19	14.8%
Green Line Northeast	25	1.9%	2	1.9%	2	1.9%
Blue Line	128	9.6%	12	9.6%	13	9.6%
Commuter Rail	**199**	**15.0%**	**19**	**15.0%**	**20**	**15.0%**
Commuter Boat	**13**	**1.0%**	**1**	**1.0%**	**1**	**1.0%**

Table 4.4
MBTA Rapid Transit Peak Hour Capacity

	PM Peak		PM	PM	Car	PM
	Cars/	Sched.	Peak Hr.	Peak Hr.	(Design)	Peak Hr.
Line/Segment	Train	Headway	Trips	Cars	Capac.	Capac.
ORANGE						
Oak Grove - Forest Hills	6	4.5 min	11	66	155	10,230
	4	4.5 min	3	12	155	1,860
Total			14	78		12,090
GREEN						
N. Sta. - Cleveland Cir.	2	7.0 min	9	18	140*	2,520
Gov't Center - Boston Col	2	6.0 min	10	20	140	2,800
Gov't Center - Riverside	3	6.0 min	4	12	140	1,680
	2	6.0 min	6	12	140	1,680
Gov't Center - Reservoir	1	10 min	6	6	140	840
Brigham Circle - Lechmere	2	8.0 min	8	16	140	2,240
Total			43	84		11,760
RED						
Alewife - Ashmont	4	8.0 min	4	16	180	2,880
	6	8.0 min	4	24	180	4,320
"Run As Directed" (RAD)	6		1	6	180	1,080
Total, Ashmont			9	46		8,280
Braintree - Alewife	4	8.0 min	3	12	180	2,160
	6	8.0 min	5	30	180	5,400
Run As Directed (RAD)	6		2	12	180	2,160
Total, Braintree			10	54		9,720
Total			19	100		18,000
BLUE						
Bowdoin - Wonderland	4	3.5 min	17	68	110	7,480
"Run as Directed" (RAD)	4	3.5 min	1	4	110	440
Total			18	72		7,920
TOTAL TRANSIT LINES			**94**	**334**		**49,770**

Source: MBTA, Operations Directorate, Planning Division: Ridership and Service Statistics, October, 1988 *Tom Humphrey, CTPS ** Note: excludes Mattapan trolley service feeding Ashmont Station

Table 4.5

MBTA Transit Line Capacities and Ridership
Peak Hour, Peak Direction

Peak Load Points	Scheduled Capacity*	Av. Passenger Load **	Volume/ Capacity
RED LINE			
Between Andrew and JFK (Ashmont)	7,200	5,400 (PM)	.75
Between Andrew and No. Quincy (Braintree)	7,560	7,350 (PM)	.97
BLUE LINE			
Between Maverick and Aquarium	7,480	6,750 (AM)	.90
ORANGE LINE NORTH			
Between Haymarket and North Station	12,090	9,300 (AM) 8,900 (PM)	.77 .74
ORANGE LINE SOUTH			
Between Back Bay and NEMC	12,090	8,800 (AM) 7,650 (PM)	.73 .63
GREEN LINE WEST			
Between Arlington and Copley	11,760	10,000 (#)	.85
GREEN LINE NORTH			
Between No. Station & Science Park	2,240	1,100 (#)	.49

* Does not include additional carrying capacity of the "Run as Directed" trains. See Table IV A-4 for capacity analyses

** Sources: MBTA Ridership and Service Statistics, Operations Directorate, Planning Division, October, 1988 page 2-8; letter from Michael Burns to Howard/Stein-Hudson, December, 1988, (included as Appendix T4).

# 1986 estimate: 125 High Street DEIR, Vanasse/Hangen, Inc.

In peak commuting hours, it is estimated that about 120-130 pedestrians will travel in the peak direction in the peak hour to or from transit (primarily the NEMC Orange Line station), and about 140-150 to and from cars. Peak pedestrian travel, however, typically occurs in the midday, when people leave the buildings for lunch or errands.

The NEMC Master Plan provides creates a number of pedestrian links in both the east-west and the north-south direction, as shown in Figure 4.6. Automobile traffic will be restricted on Bennet Street to create a pedestrian passageway, connecting Harrison Avenue and the T/NEMC parking lot to the Pratt, Proger and Floating Hospital Buildings. This path is also a connecting link to reach the MBTA NEMC station entrance on Washington Street. Another important pedestrian link will be the realigned and extended Nassau Street. Nassau Street will both be extended to reach Washington Street, and will be realigned to be parallel to Oak Street. Along Nassau Street will be a new courtyard, which will house the main entrance to the 1-C buildings. This courtyard will also provide an open area adjacent to the proposed community center on Parcel C. Landscaping and sidewalk improvements, already begun by the Medical Center, will also be continued to enhance north-south pedestrian pathways on Washington Street and Harrison Avenue.

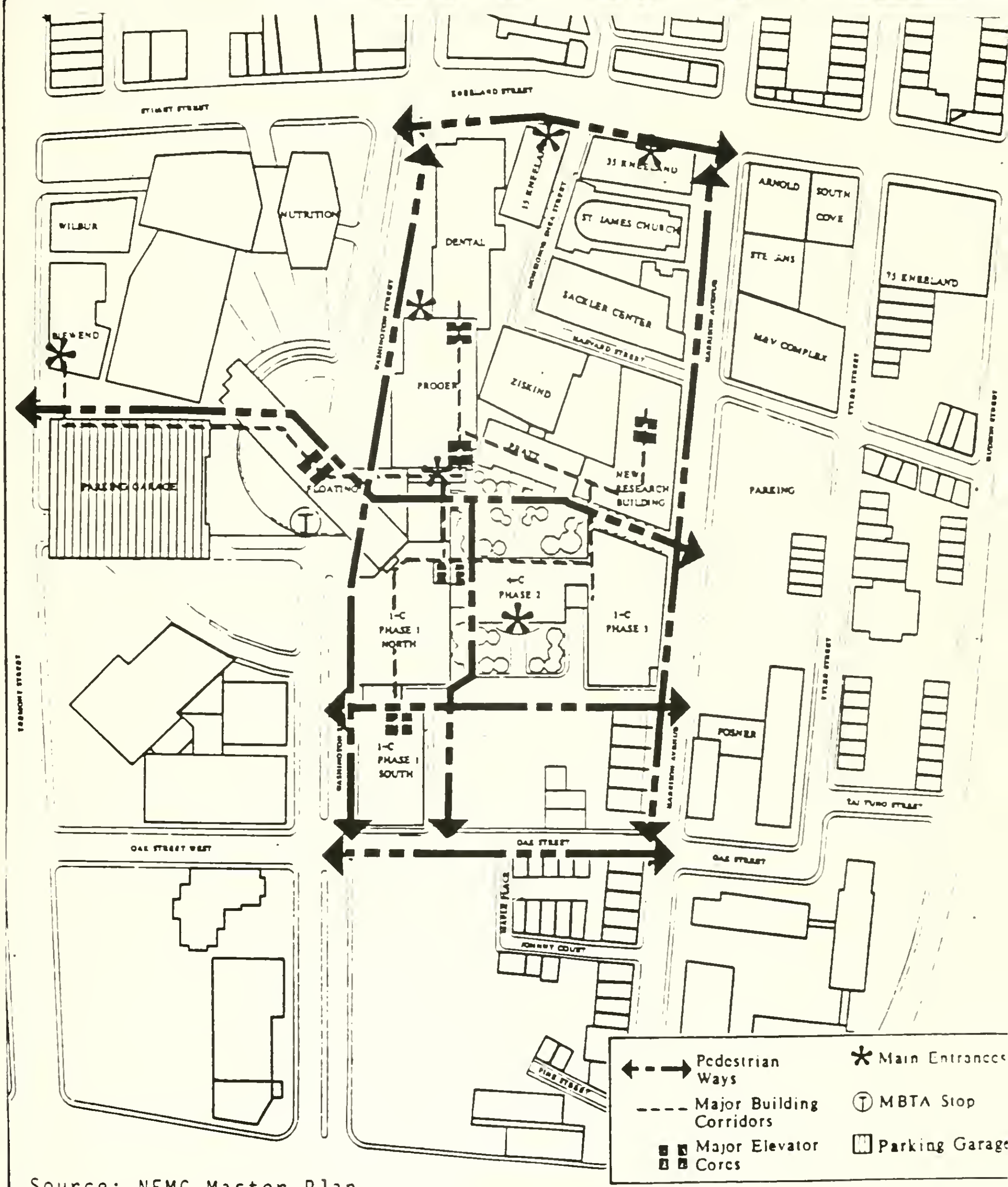
The extension of Nassau Street to Washington Street can also serve for improved vehicular circulation as a one-way westbound link. This link would allow the relatively low local access volumes to gain northbound access on Washington Street via right turns only, thereby eliminating circulation on Oak Street, in front of residential developments. Through traffic would not find this route very attractive, as the only access to the extension is from southbound Harrison Avenue, leading only to northbound Washington Street.

The Medical Center has recently engaged an urban designer to carry out the design phase of the NEMC Master Plan. The information in this impact study will help them develop measures to improve pedestrian movement in the corridors identified here.

4.10 Relative Impacts of Component Projects

This report focuses on a "project" which is actually four separate developments. To assess the relative impacts of each, it is necessary to see how much travel is generated by each. In Chapter 3, the contributions of each project to total vehicle volumes were discussed. In summary, the NEMC 1-C project contributes around 55% of peak hour trips, followed by the Recreation Center with less than 30%. The housing projects combined contribute 15-17% of peak hour trips.

This division of trips among the component projects is in a sense not too significant, as all the trips combined are a minor increment in traffic growth compared to existing and No-build volumes. Each individual project is simply a smaller subdivision of a relatively small total.



Source: NEMC Master Plan

HOWARD / STEIN-HUDSON ASSOCIATES

PEDESTRIAN CIRCULATION PLAN

N

Figure 4.6

It may be further observed, as previously noted in Section 4.6, that the vehicular access to the Recreation Center is probably overstated, due to the local service which it intends. The fact that no or very limited parking is planned for the Center underscores this point.

4.11 Overview of Construction Impacts

The chief transportation impacts that are of concern during the construction period are traffic impacts on streets leading to and around the site, worker parking, unloading and loading of construction materials and equipment, and the enclosure of the site to protect pedestrians. All these matters require City licensing, and both good planning and coordination are necessary to insure that impacts are minimized.

A detailed Construction Management Plan will have to be prepared for each project in close coordination with the construction contractor. This plan must be submitted to and approved by the City of Boston Transportation Department prior to issuance of a building permit. It is not possible to detail the Construction Management Plan at this time, due to the long public approval and project financing process involved. The City permits and controls will all require specific input from responsible City agencies, which must take into account expected conditions at the time of construction, including coordination with other public, private or utility construction going on at the same time. With this in mind, however, it is possible to state a number of principles which will guide the construction process in order to reduce negative transportation-related impacts.

First, the phasing of construction work should be coordinated with other construction activities in the area. Likewise, the components of each development must be staged to minimize transportation related and other construction impacts. The project with the greatest potential conflict is the Central Artery/Third Harbor Tunnel project, where peak construction years are currently estimated to be 1991-1994, with the downtown portions occurring toward the end of this period. The highway section with the most impact on the Medical Area will be the I90-I93 interchange, the design contract for which will probably be initiated in 1991. Coordination with construction period plans for this interchange will be necessary, once the plans and schedules for each project are finalized. Depending on implementation schedules for the NEMC and Chinatown projects, it may be that their construction will be completed prior to the Artery construction; however, if the developments are delayed for a long period, the likelihood of construction occurring within the same time as the Artery construction will increase.

4.12 Impact Perspective

Much has been analyzed and described concerning the impacts of the project in a future context. The significance of the project as one development, or more correctly stated, four developments, should be seen in the perspective of other developments. From

the vehicular point-of-view, this can be seen in Figures 4.2 and 4.3 where the total approach volumes at several key intersections are shown as bar charts depicting the existing counts, volume additions of the No-Build development, and volume contributions of the project, for AM and PM peak hour traffic. It can be readily seen that the volume contribution of the project is small with respect to the other traffic sources. The implications of this are that the project is far from alone as an incremental development in causing traffic demands which may require mitigation. On the other hand, the charts provide a general basis for assigning a share of mitigating responsibility, where and when indicated. Each of the component four developments would of course would have smaller shares, in keeping with their relative trip contributions, as discussed earlier.

What has been said for vehicle impacts also holds true in similar proportions for transit and pedestrian impacts. The new MBTA station and relocated Orange Line provides a good opportunity to increase transit usage by Medical Center staff and visitors without taxing system capacity. Sidewalks and pedestrian ways will be improved within the Medical Area as a result of the Master Plan design, and will accommodate both new and existing pedestrians more safely and more pleasantly than they do today.

5.0 MITIGATING MEASURES

5.1 Construction Period

Each of the four project sites under consideration has the potential to use side streets -- primarily Oak Street and Ash Street -- can be used for construction staging and materials storage. This will help minimize impacts on vehicular and pedestrian traffic on Washington Street. For all staging and materials storage and activities, detailed plans to minimize impacts will be set forth in the Construction Management Plan for each project and will require close coordination and monitoring to insure minimal disruption.

Workers at each site should be encouraged to use transit, rideshare, or park at off-street locations to reduce their contributions to traffic and parking around the sites to the greatest extent possible. Construction worker parking can be provided off-street in the Herald Street Garage. The Construction Management Plans will outline specific ways in which the contractor is to communicate with workers and to cooperate with the Boston Transportation Department in minimizing parking impacts. Impacts to pedestrians around the sites will be mitigated by the construction of fencing around both construction and staging areas. In addition, lighted, covered pedestrian walkways will be provided along Washington Street, Oak Street, and Marginal Road during the appropriate stages of construction.

5.2 Vehicular Traffic and Roadway System

The impact analysis has shown that the proposed projects will not degrade the roadway system beyond the No-Build Levels of Service, with the exception of the Tremont/Stuart Street intersection, which goes from LOS E to LOS F in the AM peak hour, under conditions of full buildout of NEMC Phase 1-C, Commonwealth Center, and Boston Crossing. Should the two projects proceed as planned, joint mitigation will have to be discussed among the three parties, with the relative share of costs prorated according to the degree of impact. The Parcel A, B, and C developments each contribute such small traffic volumes to the total that there is no need to institute any traffic mitigation for either of these projects, unless substantial parking for Parcel C is eventually provided as plans proceed.

In general, the major mitigating measure for the No-Build case will be the enhanced capacity offered by the Central Artery/Tunnel project, as described above, which is expected to reduce design year volumes to levels which are close to existing levels. Planning level analysis of the intersections for which Central Artery design year network data were available indicated that, even with no improvements to geometry or signal timing over existing conditions, the volume reductions listed in Section 4.5 above will provide dramatic improvements to both No-Build and Build traffic operations at study area intersections, raising LOS to E and above at all intersections listed as operating at LOS F in Section 4, above.

5.3 Transit

Given the modest scale of the proposed projects and the resultant modest travel contributions to the transit system, no specific transit mitigation is necessary. It is, however, the continuing commitment of NEMC to encourage greater transit use, as set forth in Section 5.6

5.4 Parking

As shown in the analysis of parking supply and demand, NEMC is constrained in the amount of new parking they can provide at the Herald Street, such that there will never be a surplus of employee parking. This constrained availability is probably the best mitigating measure in terms of encouraging employee ridesharing and transit use.

5.5 Pedestrian

As stated above, the pedestrian circulation measures proposed in the Master Plan will enhance pedestrian flows in the study area. In particular, the creation of a continuous east-west pedestrian way via Nassau Street will provide a protected mid-block connection between parking areas on Harrison Ave. and medical buildings on Washington Street. In addition, the creation of a pedestrian way on Bennet Street will enhance access to the MBTA station entrance on Washington Street.

5.6 TSM/Vehicular Demand Reduction

Design changes to improve the physical and operational capacity of surrounding intersections to handle development traffic are a major means of mitigating project-generated traffic impacts. However, no less important than these supply side measures are programs to help reduce the demand for auto use by employees and visitors. This can be done through several types of commute management actions, as described below. The City of Boston requires developers of major projects to enter into a Transportation Access Plan Agreement which specifies measures the developer Strategies and measures to both reduce and manage demand will be incorporated into the Access Plan Agreement.

Encourage Transit Use

NEMC's location in the midst of a residential neighborhood, and the improved transit access afforded by the relocated Orange Line and the new NEMC station makes encouragement of transit use a primary mitigating measure. However, it must be noted that in encouraging transit use in a medical center, special efforts must be made to target those employees and students for whom transit is a viable alternative. For example, night shift

workers are typically not good candidates for transit due to inconvenient schedules late at night. Fortunately, these employees do not place a burden on the street system in the traditional commuter peak hours.

NEMC and T/NEMC have been cooperating with the City, State and MBTA to encourage transit use through selling MBTA passes on site. The institutions are committed to this program, and will continue to cooperate with the MBTA in promoting the use of monthly MBTA passes.

Encourage Ridesharing

In the Boston region, developers and employers utilize the services of CARAVAN, the regional ridesharing agency, to help initiate ridesharing programs, including: carpools, vanpools, and subscription bus services. One particularly effective service which CARAVAN offers is assistance to new tenants in solving relocating employees' commute problems. This service will be utilized by the developer during the leasing process to help market the space. Once employers are located, CARAVAN will help them implement ridesharing programs and form employee carpools. The State has several funding programs in place to support private sector efforts as well.

NEMC and T/NEMC have supported ridesharing efforts through parking pricing and supply management. The current parking system which combines on-site facilities with fringe parking at Herald Street provides an easy way to encourage ridesharing through preferential parking. Reserving monthly spaces for carpools and vanpools at nearby facilities such as the Tremont St. Garage is one way to help ensure ridesharing if parking availability is limited. In addition, parking pricing could be adjusted to help encourage ridesharing, and also to help subsidize transit passes. These types of actions will be discussed more fully and developed in cooperation with the City as the 1-C EIR, PIR, and Access Plan approvals proceed.

Flexible Work Hours

Largely beyond the control of Medical Center management is the institution of flexible working hours whereby employees can vary working schedules to avoid peak demand periods. Luckily, the Medical Center working hours are naturally staggered to help spread peaks.

Transportation Coordinator

Key to successful implementation of transportation management actions is an active effort by the developer to incorporate in a positive way the idea of demand management into project marketing and leasing. This will be done through offering the services of a

transportation coordinator, who can be designated from the existing management staff. This individual will work with CARAVAN to learn about available programs, prepare the required promotional materials, and launch ridesharing and transit efforts as appropriate. Once the project is fully tenanted, the function will be carried out as part of the building management on an ongoing basis.

Transportation Management Association

In the midtown area of downtown Boston, several other major projects have been proposed over the same general time frame as NEMC Phase 1-C and the Chinatown housing developments. NEMC has been cooperating with City task forces in the Midtown Cultural District and the downtown business community in the review process for these major projects.

In the long-term, the city/community/developer group intends to evolve into what is known as a transportation management association (TMA). These types of groups were created by the private sector to help reduce traffic congestion in suburban California areas. TMAs typically involve developers, major employers, community groups, and public agencies with an interest in improving transportation conditions in a given district. The role for a TMA in the Medical area would include such issues as coordinating construction management for the projects, working with the City to ensure the implementation of programmed street improvements, deciding on circulation options, monitoring traffic and parking conditions as the projects are constructed, leased and occupied, and representing the area's interests with respect to major projects such as the Central Artery/Third Harbor Tunnel and future MBTA initiatives. T/NEMC largely serves in this role already, through its coordinating function for parking and transportation in the area.

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